THE UNIVERSITY
OF ILLINOIS
LIBRARY
666.105
GLA
V. 3
REMOTE STORAGE
[illegible]

ENGINEERING

#1 bd in vol 2

GLASS

THE RECOGNIZED ORGAN OF THE GLASS INDUSTRY
Published on the Tenth of Each Month.

Single Copies - - - - One Shilling
Annual Subscription - - 10/6 post free

GLASS PUBLICATIONS Ltd.
TECHNICAL PUBLISHERS,
Talbot House,
Arundel Street,
Telephone: CENTRAL 5985. **Strand, London, W.C.2.**

CONTENTS.

	PAGE
Editorial Notes	43
Defects in Glass.—By Dr. C. J. Peddle, M.B.E., F.I.C.	44
Strainviewers.—By C. F. Smith	46
The Use of Compressed Air.—By Robert Wilson ...	48
The Optical Society	51
Some Features of Tank Block Comparisons.—By F. S. Thompson and H. I. Vormelker	53
The Society of Glass Technology	59
Automatic Bottles Makers' Co., Ltd.	63
Trade Notes	65
The Physical Society of London and The Optical Society Exhibition	67
The Lubrication of Air Compressors	69
Legislation Expected in 1926.—By Our City Correspondent	73
November Trade Returns	75
United States Patents	77
British Patents	80
Latest British Patents	83

We take this opportunity of conveying to our readers our sincere wishes that the year just commencing will be happy and prosperous for them both personally and commercially.

Editorial Notes.

In our issue for December 1923 we published an article on the need for a Federation of Glass Manufacturers. The author, Mr. R. S. Biram, pointed out the benefits which such an organisation would confer, but at that time it appeared as if glass manufacturers thought the idea unworkable.

Since 1923, however, there have been numerous occasions upon which a National Federation would have been of inestimable value to the manufacturer's interests and apparently this fact has at last been realised because early in December, 1925 a circular letter, bearing the signature of Sir Sydney Henn, was sent to all British bottle and glass container manufacturers, asking for an expression of their views on the proposal to form a Federation of Bottle and Glass Container Manufacturers. The letter further stated that the proposal has been submitted to the chairmen of the various local Associations which are in existence and that the scheme had their approval.

It should not be necessary at the present time to enumerate the advantages to be obtained from concerted efforts. "United we stand, divided we fall," is too old a slogan to require further emphasis, yet we must admit that we have been surprised to find that in some instances those who would receive the most benefit from the proposed organisation have been the most dubious as to it's advisability.

Cautiousness is a very desirable feature when dealing with most business questions but unfortunately in the glass trade caution is replaced by suspicion far too frequently. This is much to be regretted as distrust must disappear before it will be possible for anything to be done to help the industry. Too much time and energy is devoted to looking for the "snag" or the "nigger" when a scheme like the present one is put forward; if one cannot be found the sponsors of the scheme are then classed as being exceedingly "smart" or "clever" and suspicion becomes even more pronounced.

The only possible foundation upon which an Association or Federation of Manufacturers can be built up, is that of mutual trust and co-operation and in view of the absolute necessity and urgency of the question we think that this condition should not be very difficult to obtain. The objects of the Federation as outlined in the circular letter are most certainly of interest and importance to all manufacturers, who would seem to have all to gain and nothing to lose by it's foundation.

Of course, it will be stated that we are becoming a nation of Associations and Societies and that a manufacturer has no time to attend to manufacturing on account of the number of conferences and meetings he has to attend. This may contain a certain amount of truth but if only manufacturers will consider what they have at stake we are confident that they will give the new scheme a chance, even if it means sacrificing an old one.

At the present time there are many questions upon which the opinion and action of the proposed Federation would be of value to the industry, and once established we think that there would eventually be an *International* Federation, much upon the same lines as the already existing International Chamber of Commerce.

[GLASS *will deal with all matters pertaining to the industry in an impartial manner, consequently the Editor does not necessarily associate himself with the opinions expressed by his contributors.*]

Defects in Glass.

No. 9—The Influence of Constitution upon Durability.

By DR. C. J. PEDDLE, M.B.E., F.I.C.

(1) The simplest normal glass is one consisting of two radicles, one acidic and one basic, the acidic radicle being refractory (usual silica) and the basic radicle being a flux. Glasses of this type can be made by melting together silica and a compound of either sodium or potassium, e.g. sand and soda ash when melted in correct proportions give soda-silica glasses the composition of which can be expressed in terms of silica and sodium oxide. The durabilities of these soda-silica and potash-silica glasses are very small. Thus a glass containing 72% silica and 28% sodium oxide is quite greasy after a week's exposure to the air, owing to the attack of moisture, and after a year's exposure is covered with a thick white powdery film. The weathering of soda-silica glasses containing a higher proportion of sodium oxide is even more pronounced, the glass containing 50% sodium oxide being covered with a thick white crystalline film after only a week's exposure to air. The poor durability of these glasses is also proved by the "powder test." It has been found for example that all these alkali-silica glasses containing upwards of 28% of the alkaline oxide can be dissolved wholly when they are powdered and boiled with water.

(2) Since a simple glass consisting of silica and an alkaline oxide is not durable it is necessary to introduce into its composition a "stabilising" oxide in order to endow it with durability. The "stabilising" oxide as a rule is one of the common dibasic oxides, although alumina (which is tribasic) may also be employed. The commonest stabilising oxides are calcium oxide (in lime glasses) and lead oxide (in lead flint glasses) but the oxides of zinc, magnesium, barium, strontium and aluminium will also serve. The compostion of a stable "crown" glass, as for example bottle glass or window glass can be expressed in terms of silica, sodium oxide (or potassium oxide) and calcium oxide, whilst a "lead" glass for table ware can be expressed in terms of silica, potassium oxide and lead oxide. The effect upon durability of introducing glass (100 grams) with water for one hour. calcium oxide (lime) into a glass in place of sodium oxide is evidenced by the first of the following tables. The second table indicates the effect of substitution of lead oxide for sodium oxide. The first three columns give the composition of the glasses (approximately). The fourth column denotes the weight (in milligrams) of the glass that is dissolved by boiling produced The next column shows the "sulphuric acid" factor for each glass i.e. the number of milligrams of acid required to neutralise the liquid after boiling 100 grams of the powdered glass for one hour. The two last columns indicate the effect upon the polished glass surface after it has been exposed to the atmosphere for 100 hours and one year.

It will be seen from these tables that successive substitutions of sodium oxide by the dibasic oxide results in a striking improvement in the durability of the glass. Another fact revealed by these results is that dibasic oxides have not the same effect weight for weight upon durability, for it is evident that a 5% substitution by calcium oxide has a much greater effect in improving the weathering properties than a 5% substitution by lead oxide. Experiment has shown* that the best dibasic oxide for conferring durability is zinc oxide, followed by the oxides of magnesium, calcium, strontium, barium and lead in the order named.

TABLE I.

No.	Composition.			Weight dissolved (mgs.)	Sulphuric acid factor.	After an exposure of 100 hours to moist air at 18° C.	After one year's exposure to ordinary air.
	Silica.	Sodium Oxide.	Calcium Oxide.				
1	70	30	—	Totally	soluble.	Very greasy indeed	Thin white powdery film
2	70	25	5	1840	5317	Covered with greasy spots	Very pronounced film
3	70	20	10	952	1638	Greasy	Pronounced film
4	70	15	15	688	436	Slightly greasy	Slight film all over
5	70	10	20	420	292	Unaffected	Extremely slight film

(3) The durability of a glass is largely dependent upon the amount of alkaline oxide present, and there

---

* Peddle, Trans. Opt. Soc. Vol. 23, 1921-22, p. 103.

666.105
GLA
v.3

REMOTE STORAGE

is not a great amount of difference in the relative effects of the oxides of sodium and potassium, although there is evidence that a glass containing potassium oxide is somewhat more durable than the corresponding glass with an equal weight of sodium oxide as its alkaline oxide. One very striking fact, however, must be emphasised, that a glass containing appreciable amounts of *both* alkaline oxides is more durable than the corresponding glass containing the same percentage amount of either sodium oxide or potassium oxide. The following results illustrate this in the case of certain lime and certain lead glasses :—

Composition.				" Sulphuric Acid " factor (see " powder test ")
Silica.	Calcium Oxide.	Sodium Oxide.	Pot. Oxide.	
70%	10%	20%	—	1638 milligrams
70%	10%	10%	10%	674 ,,
70%	10%	—	20%	749 ,,
70%	15%	15%	—	436 ,,
70%	15%	7½%	7½%	223 ,,
70%	15%	--	15%	240 ,,
Silica.	Lead Oxide.	Sodium Oxide.	Pot. Oxide.	Sulphuric Acid factor.
60%	20%	20%	—	7891 milligrams
60%	20%	10%	10%	3523 ,,
60%	20%	—	20%	7775 ,,
60%	25%	15%	—	2122 ,,
60%	25%	7½%	7½%	711 ,,
60%	25%	—	15%	848 ,,

The durability of each glass is expressed in milligrams of sulphuric acid required to neutralise the liquid obtained after boiling 100 grams of powdered glass with water for an hour (i.e. the sulphuric acid factor) and it will be seen in the four sets of corresponding glasses given, that the glass containing both alkaline oxides has a higher durability than the glass containing soda alone or potash alone.

A very thorough investigation has been made of this remarkable phenomenon, the work embracing glasses containing all the common dibasic stabilising oxides, and as a result the following generalisation has been put forward :—

" *In the silica—alkali—RO glasses (where RO is the oxide of zinc, magnesium, calcium, strontium, barium or lead) when the total alkali is less than 20% the glass containing both alkalis in equal proportion by weight will be more durable than the corresponding glass containing all its alkali as sodium oxide or as potassium oxide. This is true whatever the proportion of silica or RO in the glass.*"*

It will be seen that the phenomenon is true over a very wide range. It breaks down when the alkali content is over 20%, but seeing that practically every commercial glass upon the market to-day contains less than 20% of alkali, the generalisation can be taken as applying to all commercial glasses.

(5) The researches referred to above definitely established the fact that the presence of both alkalis in equal percentage amount by weight in a glass made for better durability. The question at once arises whether having the two alkalis present in equal percentage amounts gives the best durability for a given total percentage of alkali, or whether there is some better proportion. Researches carried out upon the lead glasses indicated that a maximum durability was obtained when the ratio of sodium oxide to potassium oxide was 3 to 7.†

(6) It has been well established that alumina is a valuable constituent in glass, from the point of view of increasing durability. It helps to give the glass in which it is present high powers of resistance to attack by water, acids and solutions of alkalis. For this reason it almost invariably finds a place in glasses for chemical ware, the amount present being between 6% and 10%. Such large amounts of this oxide render these glasses difficult to melt, and it is not usually expedient to incorporate even 6% of alumina in window glass and bottle glass with a view to improving durability The presence of 3% of alumina in these glasses does not interfere with their melting properties to any large extent, and this amount is to be advocated to increase stability.

(7) Boric oxide under certain circumstances improves the durability of the glass in which it is present. It has been shown for example‡ that two parts of borax

TABLE II.

No.	Composition.			Weight dissolved (mgs.)	Sulphuric acid factor.	After an exposure of 100 hours to moist air at 18° C.	After one year's exposure to ordinary air.
	Silica.	Sodium Oxide.	Lead Oxide.				
1	70	30	—	Totally	soluble.	Very greasy indeed	Thin white powdery film
6	70	25	5	82450	34200	Covered with wet spots	Badly dulled. A few crystals
7	70	20	10	10900	9232	Do. (less than No. 6)	Distinct spotted film
8	70	15	15	2810	2906	Unaffected	Very faint signs of attack

---

* "Feddle's generalisation " see Travers Jour. Soc. Glass Tech. 1921, Vol. 5. p. 200.

† Peddle, Jour. Soc. Glass Tech, 1921, Vol. 5, p. 195.

‡ Hodkin and Turner, Jour. Soc. Glass Tech. 1920, Vol. 4. p. 120.

[*Continued on page* 47.

663475

Strainviewers.

By C. F. SMITH.

The importance of correct annealing in the production of glassware is well known to manufacturers, and in recent years some progress has been made in the application of scientific methods to annealing and subsequent inspection.

The article on "Faulty Annealing" by Dr. Peddle in the October issue of this Journal was an excellent account of these methods and of the research work done by various investigators. The value of optical methods in the testing of glassware was emphasised by Dr. Peddle and the following description of some commercial polarimetric apparatus on the market should therefore be of interest.

The bi-refracting qualities of insufficiently annealed glass have been known for more than a century, and so also has the polarimetric method of observation. Sir David Brewster, in his book on *Optics*, published in 1834, dealt at some length with this subject and the strainviewer of to-day is essentially the same as that used by him.

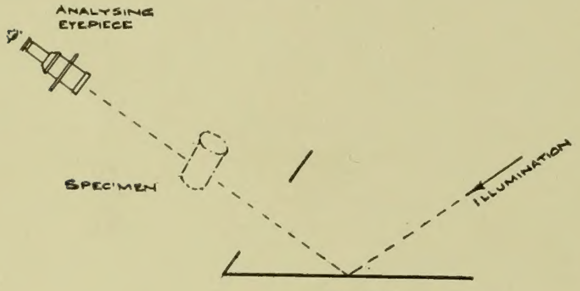


Fig. 1.

In the design of strainviewers made by Adam Hilger Ltd., London, great attention has been paid to detail and the proper illumination of the articles to be examined. The latter point is regarded as of the utmost importance, since although there may be no trouble with thin walled vessels or sheet, difficulties are often met when solid objects or vessels of distorted shapes are to be examined. This is easily realised when one thinks of the deep shadows seen when a thick walled or "raised bottom" bottle is held to the light, and these shadows may obscure entirely any effects of strain due to bad annealing. Further, the largest possible aperture has been provided to enable large objects to be examined and this is limited by the distance at which the object is to be held, usually at arm's length.

Fig. 1 shows the optical system in most use in strainviewers and this contains explanatory references to the parts. Light from a diffusing source is reflected at the polarising angle from a sheet of black glass and the object is observed through an analysing eyepiece. This eyepiece contains lenses designed for observation of a wide field, a nicol prism, and a component known as a waveplate, the latter having the important property of showing the presence of strain in glass by brilliant colouring. Strain may be observed in the absence of the waveplate but in gradations of white to black, and thus in many cases is difficult to distinguish from shadow effects. The waveplate was used by Sir David Brewster and was revived in the course of the development of the manufacture of glass during the war by Mr. F. E. Lamplough, M.A. Although this article is limited to a description of strainviewers it does not seem out of place to mention what is apparently a fundamental law governing the conditions for correct annealing. As a result of experimental work on a large number of glasses Twyman[*] found that the mobility doubled for every 8° C rise in temperature. For example a glass which when heated at 540° C for three minutes lost 95% of any strain present, would require six minutes at a temperature of 532° C to produce the same result. This rule is easy to remember and will without doubt become well known by those controlling the annealing of glass.

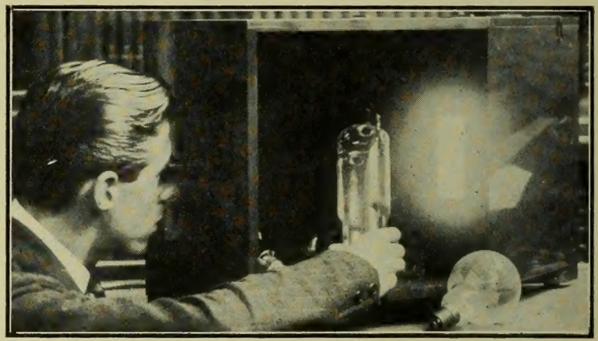


Fig. 2.

Fig. 2 shows a popular model of strainviewer in use in the examination of glass jars, and this is solidly made in mahogany with an iron lamphouse. The compartment in which the glassware is held for observation is approximately twelve inches square and twelve inches deep, thus enabling a large variety of objects to be examined, and a door (not seen in the photograph), is an added convenience when dealing with glass tubes.

Much experimental work has been done in order to overcome the difficulties introduced by coloured objects, and the most efficient arrangement is that in which a special diffusing screen is placed between the polarising plate and the object to be examined, instead of near the lamp. This enables a large variety of coloured objects to be examined and results in only a small reduction in sensitivity in the case of white glass.

Fig. 3 shows another model adapted for use with daylight, a form which is often convenient when the instrument has to be carried about or when an electric supply is absent or of differing voltages.

---

[*] Jour. Soc. Glass Tech. 1917, Vol. 1, p. 61.

Fig. 4 is a photograph taken through the analysing eyepiece of a strainviewer, and shows the locality in which strain is present in the lamp chimney under examination. Owing to the limitations of reproduction these effects are not shown so effectively as in the instrument where they can be seen in brilliant green and red tints.

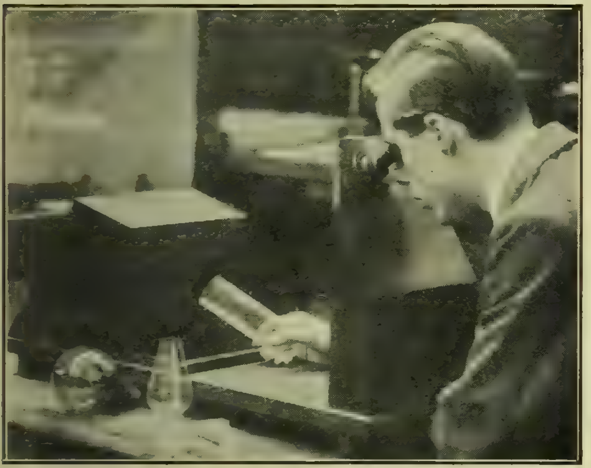


Fig. 3.

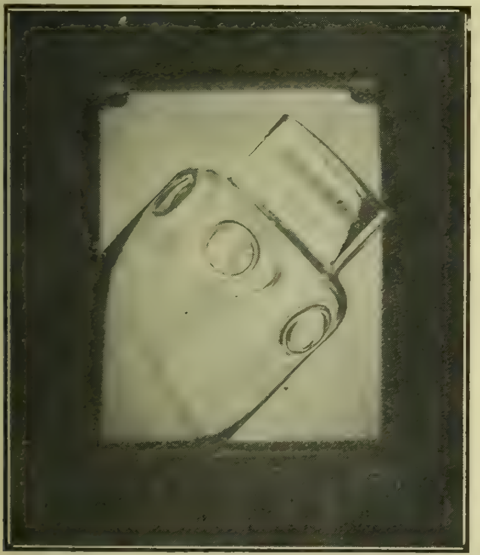


Fig. 4.

Experimental work has been done from time to time at the works of Adam Hilger Ltd., to meet special cases, as a result of which strainviewers have been constructed to examine at a glance the whole surface of green glass insulators twelve inches in diameter. Further, designs are available for the construction of strainviewers suitable for inspecting glass with extremely deep colouring, for the projection of strain effects in white glass, and a strainviewer occupying the space of a large room for dealing with large searchlight mirrors or plate glass.

Defects in Glass.—

Continued from page 45.

per 100 parts of sand in the batch exercises a notable beneficial effect on the durability of lead glasses. The beneficial effect of boric acid in assisting the resistance of the attack of glass towards water, appears to reach a maximum at about 12% of this oxide. Subsequent additions of the oxide cause the durability to decrease rapidly*

(8) Many attempts have been made from time to time to determine the best ratio between the oxides in a glass, to give maximum durability, and formulæ have been advanced to represent the "best" glass. The formula which has received most attention has been $6SiO_2$, $R'_2O\ R''O$ where R'_2O represents a molecule of either sodium oxide or potassium oxide and $R''O$ a molecule of any of the dibasic oxides. This molecular formula due in the first case to Benrath is based upon a ratio of one molecule of basic oxide to three molecules of acid oxide and is therefore termed a "trisilicate" formula. Applying it to a soda-lime glass the composition of the glass would be 75.4% silica, 11.7% calcium oxide and 12.9% sodium oxide. An examination of the compositions of many well known soda lime glasses reveals the fact that they approximate this composition, being as a rule richer in lime and poorer in soda for hand made ware and window glass, whilst for machine made ware the proportion of sodium oxide increases and the calcium oxide decreases.

(9) The following rules may be given for improving the durability of a glass.

(*a*) Replacing a proportion of alkaline oxide by either silica or a dibasic oxide increases the stability. At the same time the melting temperature of the glass is raised.

(*b*) Substitution of silica by a dibasic oxide, the alkali remaining constant, improves durability. Substitution by alumina has the same effect. Where a dibasic oxide replaces silica the melting properties of the glass are improved, but if the dibasic oxide is lime, the devitrification tendencies of the glass are enhanced. Substitution of alumina up to 3% has no deterrent effect upon melting; above this the glass becomes more difficult to melt.

(*c*) Where only one alkaline oxide is present as a fluxing oxide, durability is improved by a substitution of a portion of it by the other alkaline oxide. The melting properties will show slight improvement.

(*d*) The addition of small amounts of boric oxide increase the resisting powers of glass to weathering, and at the same time improve conditions of melting.

---

* *Turner*, Jour. Amer. Cer. Soc. 1924, Vol. 7, p. 313.

IRISH GLASS BOTTLE COMPANY.

Registered in Dublin, capital, £75,000 (15,000 "A" cumulative preference and 55,000 "B" cumulative participating preference of £1 and 100,000 ordinary of 1s.). To acquire undertakings, assets and liabilities of Irish Glass Bottle Company (incorporated in 1920) and Ringsend Bottle Company and carry on business of glass, glass bottle and stopper manufacturers, etc. Registered office Charlotte Quay, Ringsend, Dublin.

The Use of Compressed Air—*Continued.*

By ROBERT WILSON.

Volumetric Efficiency. Volumetric efficiency, in the real sense of the term and as it it is intended to be understood by the user of compressed air, means the ratio of *capacity to piston displacement.* It is important to remember that " capacity " is the actual volume of free air compressed and delivered per minute, and as " free air " is air at normal atmospheric pressure and temperature as measured at the intake to the compressor cylinder, it follows that a true comparison for volumetric efficiency must include all sources of volumetric loss resulting from any changes from these standards.

The sources of volumetric loss, as was explained in a preceding article, comprise the losses due to (1) clearance, (2) change of temperature, (3) low suction pressure, and (4) leakage. The loss of volume resulting from the re-expansion of the compressed air left in the clearance space has been already referred to in previous articles, and while it probably is realised that this loss varies with the terminal pressure in the cylinder, it is doubtful if the effect of temperature on the clearance loss and on the capacity of the compressor, is realised to anything like its full extent.

That it is impossible to compress air without raising its temperature was also explained in a previous article; and as it is well-known that air can be made to expand by the application of heat, it follows that temperature is an important factor in the determination of " real " volumetric efficiency. This will be more apparent from a brief survey of the compressor cycle. *Firstly*, the heat produced by compression not only increases the temperature of the air but also heats the surrounding metal; *secondly*, the hot compressed air left in the clearance space is in contact with the hot metal surfaces throughout the process of re-expansion; *thirdly*, the fresh air drawn into the cylinder passes through the hot inlet valves, is swept against the hot metal in the cylinder, and mixes with the air re-expanded from the clearance space.

It will be obvious from this survey that the air drawn into the cylinder is bound to be heated before compression commences, and that the air derives this initial heat not only from the hot metal surfaces but also from the air re-expanded from the clearance space.

The metal of the cylinder walls, piston, cover, and valves, attains a temperature approaching the final temperature of compression, the lower temperature of the metal being due to the cooling effect of the water jackets and to radiation, so that during the first portion of re-expansion the higher temperature air causes heat to flow from the air to the metal. This will continue until the temperatures of the air and the metal are the same, but as expansion continues the temperature of the air is reduced below that of the metal, and heat is then transferred from the metal to the air at a rate which increases as expansion proceeds back to the initial pressure.

The heat transferred to the air during re-expansion has a considerable influence on the loss of volume due to clearance, in so far that expansion is continued for a longer period than would be the case if no heat entered the air during the process. To comprehend this in a general way, it is necessary to recapitulate the principles of isothermal and adiabatic compression and expansion.

If air could be compressed or expanded isothermally the temperature would be the same at the end as at the beginning of the process; and if the temperature remained unchanged the volume would vary in inverse proportion to the pressure. That is, if the volume were increased by expansion, the pressure would be reduced proportionately. During adiabatic compression or expansion no heat leaves or enters the air during the process. The effect of this, during compression, is to cause the pressure to *rise* faster than the volume diminishes—due to the heat expanding the air which is being compressed—and during expansion, to cause the pressure to *fall* faster than the volume increases—due to the heat necessary to do the work of expansion having to be derived from the air itself—but as the heat available to do the work of expansion is that retained by the air during compression, it follows that the temperature at the end of adiabatic re-expansion would be the same as at the beginning of adiabatic compression.

Since, as has been explained above, heat is first transferred from the expanding air to the metal and later from the metal to the air, it follows that re-expansion of the clearance air will be neither isothermal nor adiabatic. For isothermal expansion, heat must be supplied from some external source to maintain the temperature constant, but as the source from which the air derives its heat is the hot surrounding metal—which, generally, is lower in temperature than the maximum temperature of the air—the heat transfer necessary to secure isothermal re-expansion cannot be obtained. Since, however, heat from the metal does enter the air, adiabatic re-expansion also is impossible. The mean result of the process, therefore, is that the law for the re-expansion of the clearance air lies somewhere between the isothermal and the adiabatic; and because the rate of heat transfer from the metal to the air increases as expansion continues, the re-expansion process will approach more closely to the isothermal as the compression ratio—and consequently also the expansion ratio—increases. The volume occupied by the re-expanded clearance air, therefore, is greater than if adiabatic re-expansion were possible, and will approach that consistent with the isothermal process as the difference between the initial and terminal pressures in the cylinder increases. Thus, *the changes of temperature within the cylinder will have a decided effect on the volumetric loss due to clearance.*

The fact that adiabatic re-expansion is impossible, not only reduces the length of the effective stroke but also creates a high temperature at the end of the re-expansion process—the temperature increasing as the process approaches the isothermal—and it is with this high temperature air that the incoming air has to mix. The incoming air, however, is heated by contact with the hot metal surrounding the cylinder before being further heated by mixing with the re-expanded clearance air.

The effect of this initial heating is to cause the incoming air to expand, the rate of expansion, when the pressure is constant, being directly proportional to the absolute temperatures. As the pressure, during the suction stroke, may be assumed to be constant, it follows that the volume of " free air " equivalent to the actual volume of air drawn into the cylinder at each suction stroke, will decrease as the temperature of the air at the end of the suction stroke increases; and also *that this initial heating reduces the volumetric efficiency.*

It will be apparent from the foregoing that it is necessary to determine, *first*, the law for the re-expansion of the clearance air, and, *second*, the rise in temperature due to the incoming air taking heat from the hot metal surrounding the cylinder, before the volumetric losses due to clearance and temperature can be calculated.

The factors which determine the law of expansion between given pressures are the temperatures at the beginning and end of the process. If these are different, and the difference is known, it is possible to determine the law of expansion, but it should be noted that the difference of temperature only is important and that the law is unaffected by whatever may be the temperature at the beginning. This means, for any law of expansion, that the temperature at the end of the process will depend upon the temperature at the beginning.

It is not easy to determine the changes of temperature in the compressor cylinder, as several factors operate against accuracy, both as regards computation and observation. Obviously, the temperature at the beginning of re-expansion will depend upon the final temperature of compression; but the final temperature of compression depends upon the temperature at the beginning of compression. Thus, the final temperature of compression cannot be computed accurately by taking the known values for the compression ratio and for atmospheric temperature, even if adiabatic compression is assumed, as the value for the initial temperature in such a calculation must be the actual temperature of the air at the beginning of compression. Neither is it accurate to take the observed temperature at the discharge branch of the compressor as representing the final temperature in the cylinder. A certain amount of cooling takes place during the discharge of the compressed air from the cylinder, as the result of the slight re-expansion which occurs when the discharge valves open—the final cylinder pressure always being slightly higher than the receiver pressure (as explained in page 938, September, 1925), and to radiation during the passage of the air through the water jacketted valves and ports. Thus, the temperature at the discharge branch usually is lower than the temperature in the cylinder, and may compare with the adiabatic computation when the observed or assumed temperature of the atmosphere is used in the calculation, depending, of course, upon the quantity of heat given up during the passage of the air through the valves and ports.

The final temperature in the cylinder can be ascertained by means of a thermometer placed in an oil pocket which is exposed to the air being compressed, but the changes of temperature in the cylinder take place too rapidly for the thermometer to show also the temperatures at the beginning and end of re-expansion and at the beginning of compression.

It is obvious, therefore, that the calculations for the volumetric loss due to imperfect re-expansion must be based on assumptions, but since imperfect re-expansion affects both the clearance loss and the temperature at the beginning of compression, it is more important to make these assumptions than to ignore the effects of imperfect re-expansion alogether.

The fact, as has been shown, that the re-expansion of the clearance air follows a law which lies between the isothermal and the adiabatic is of some assistance in elucidating this matter. The fundamental equation for the isothermal law is $P_1 V_1 = P_2 V_2$, and for the adiabatic law $P_1 V_1^n = P_2 V_2^n$, the value of the index n being equal to 1.41. Therefore, an equation for the law which lies midway between these two would be say $P_1 V_1^{1.2} = P_2 V_2^{1.2}$.

For the purposes of the calculations which follow later, the equation for the law of re-expansion of the clearance air will be assumed to be $P_1 V_1^{1.2} = P_2 V_2^{1.2}$, and it can be assumed also that compression is adiabatic.

The same factors which operate against accuracy in determining the law of re-expansion also make necessary the use of assumptions for estimating the probable temperature of the air in the cylinder at the beginning of the compression stroke. From the assumptions already decided upon for the laws of compression and re-expansion, the temperature at the end of re-expansion can be calculated approximately, but the extent of the heating of the incoming air by contact with the metal is a matter for pure speculation. It is impossible even to approximate this with any degree of certainty, unless data, obtained by observation, is available. The importance, however, of this initial heating has already been referred to and will be obvious from the calculations which follow later. If the rise is assumed to be say 10° F, this will not err on the extravagant side.

The other sources of volumetric loss are low suction pressure and leakage. That the pressure during the suction stroke is liable to fall slightly below the observed barometric pressure of the atmosphere has already been explained (page 938, September, 1925), but to measure this accurately, the indicator must be fitted with a spring lighter than the one used usually to measure the discharge pressure. As a rule, the difference is so little between the lines of suction and atmospheric pressure, as shown on the indicator diagram, that accurate measurement is impossible. The extent of the volumetric loss due to low suction pressure will be apparent from the following example.

Example (1). The observed atmospheric pressure was 14.7 lb. per sq. in., absolute, and the suction pressure as measured from the indicator diagram was 14.6375 lb.: calculate the reduction in volumetric efficiency resulting from the lower suction pressure.

$$V_i \qquad V_a \frac{P_i}{P_a}$$

where Va is the volume of air at atmospheric pressure Pa, and Vi is the volume of air at suction pressure P_1.

Therefore, the ratio between the volume of air at atmospheric pressure and that at suction pressure is,

$$\frac{V_1}{V_a} = \frac{P_1}{P_a} = \frac{14.6375}{14.7} = .996$$

The drop in pressure $= 14.7 - 14.6375$
$= .0625$ lb.
$= \frac{1}{16}$ lb. or 1 oz.

Therefore, the volumetric loss *per ounce* difference between atmospheric and suction pressures is equal to 0.4%.

If ample valve area is provided the volumetric loss resulting from low suction pressure will not be serious, but it will be clear from the above example that a pressure reduction amounting to several ounces would have a serious effect on volumetric efficiency. A pressure drop of 4 ozs. is not unusual and is often exceeded. For the purposes of the calculations this loss can be taken as say 1.5%, equal to a pressure drop of $3\frac{3}{4}$ ozs.

Leakage may occur at the valves or past the piston and piston rings, and will vary with the pressure; but being constant for any given pressure, will be a greater percentage of the piston displacement at any speed lower than the full speed of the compressor. If the valves and piston rings are a perfect fit and the joints of the piston rings are fitted as close as working clearances will permit, leakage will be a very small percentage, and such as could be neglected; but perfect fitting cannot always be relied upon and it is perhaps advisable to make a slight allowance for leakage loss, say 1%. (If, however, the reverse should be the case in actual working, then it will readily be apparent that serious leakage of hot compressed air, either at the valves or past the piston, would upset all theoretical calculations. The re-expansion loss would be increased, but probably the worst effect would be the resultant high initial temperature, which, in turn, would produce an exceptionally high final temperature of compression, and create for uneconomical and dangerous working conditions).

The summary of the volumetric losses which occur during the compressor cycle, together with the assumptions decided upon to enable these losses to be calculated, will be, from the foregoing, as follows :—

(1) Volumetric loss due to clearance.
  (a) Mean law of compression assumed to be adiabatic.
  (b) The equation for the mean law of re-expansion assumed to be $P_1 V_1^{1.2} = P_2 V_2^{1.2}$.
(2) Volumetric loss due to initial heating of the air drawn into the cylinder.
  (c) Temperature of incoming air assumed to be raised 10°F. by contact with hot metal only.
(3) Volumetric loss due to low suction pressure.
  (d) Assumed to be 1.5%.
(4) Volumetric loss due to leakage.
  (e) Assumed to be 1%.

The reductions in volumetric efficiency, as the result of the losses due to clearance and initial heating are best elucidated by reference to the theoretical air compressor diagram, but to calculate these losses it is necessary to refer to some of the general equations from which can be derived the relations between pressures, volumes, and temperatures, for isothermal and adiabatic conditions respectively. For convenience, therefore, the general equations for air, as commonly used, are set out below, these being derived from the fundamental equations $P_1 V_1 = P_2 V_2$ (Isothermal) and $P_1 V^n = P_2 V_2^n$ (Adiabatic).

General equations relating to air.

(1) For a given change of Pressure.
Isothermal. With temperature unchanged.

$$V_2 = V_1 \left(\frac{P_1}{P_2}\right) \quad \ldots \quad \ldots \quad (5)$$

With volume unchanged.

$$T_2 = T_1 \left(\frac{P_2}{P_1}\right) \quad \ldots \quad \ldots \quad (6)$$

Adiabatic. Change of volume.

$$V_2 = V_1 \left(\frac{P_1}{P_2}\right)^{\frac{1}{n}} \quad \ldots \quad (7)$$

Change of temperature.

$$T_2 = T_1 \left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} \quad \ldots \quad (8)$$

(2) For a given change of volume.
Isothermal. With temperature unchanged.

$$P_2 = P_1 \left(\frac{V_1}{V_2}\right) \quad \ldots \quad \ldots \quad (9)$$

With pressure unchanged.

$$T_2 = T_1 \left(\frac{V_2}{V_1}\right) \quad \ldots \quad \ldots \quad (10)$$

Adiabatic. Change of pressure.

$$P_2 = P_1 \left(\frac{V_1}{V_2}\right)^{n} \quad \ldots \quad (11)$$

Change of temperature.

$$T_2 = T_1 \left(\frac{V_1}{V_2}\right)^{n-1} \quad \ldots \quad (12)$$

(3) For a given change of temperature.
Isothermal. With pressure unchanged.

$$V_2 = V_1 \left(\frac{T_2}{T_1}\right) \quad \ldots \quad \ldots \quad (13)$$

With volume unchanged.

$$P_2 = P_1 \left(\frac{T_2}{T_1}\right) \quad \ldots \quad \ldots \quad (14)$$

Adiabatic. Change of pressure.

$$P_2 = P_1 \left(\frac{T_2}{T_1}\right)^{\frac{n}{n-1}} \quad \ldots \quad (15)$$

Change of volume.

$$V_2 = V_1 \left(\frac{T_1}{T_2}\right)^{\frac{1}{n-1}} \quad \ldots \quad (16)$$

where T_1 and P_1 = the absolute temperature and absolute pressure corresponding to volume V_1.
T_2 and P_2 = the absolute temperature and absolute pressure corresponding to volume V_2.
n = the index for compression and expansion.

THE OPTICAL SOCIETY.

At a meeting of The Optical Society held on 10th December, 1925—Mr. T. Smith, President, in the Chair—the following papers were presented and discussed.

"**General Principles of Photographic Surveying,**" By Colonel H. S. L. Winterbotham, C.M.G., D.S.O., R.E.

The paper gives a brief outline of the development of photogrammetry from terrestrial and aerial positions, and an indication of some of the points to be considered in the design of instruments required by the photogrammetric surveyor in this country. The instruments originally used, such as the Canadian type of survey camera, were of the nature of photographic theodolites. No optical machinery was available for utilising the views taken by the camera. It was soon established that the use of stereoscopy facilitated the identification of points common to different views. The introduction of the Zeiss comparator with its movements of one plate relative to the other (parallectic angle), of both plates sideways (orientation), of both plates up and down (height), led to a considerable reduction in the time of plotting and greatly improved contouring. The stereoautograph of von Orel embodied the optical properties of the comparator, and in addition, mechanical arrangements which enabled the observer to plot mechanically, the time required to plot one point being reduced from 5 minutes to 1 minute. In the case of photographs taken by a simple camera in the air, it is difficult to reconstruct a 3-dimensional landscape from a 2-dimensional picture, unless the points of exposure have been established. Optical mechanical instruments are now in course of construction which will do for surveys from the air what the stereoautograph of von Orel does from photographs from the ground.

"**Perspective Conditions of Photogrammetry,**" by Lt.-Colonel W. N. MacLeod, D.S.O., M.C., R.E.

The perspective conditions which must be satisfied in aerial survey work are discussed and the methods of reconstructing these conditions from the photographs obtained are described, reference being made to such instruments as the rectifying camera, the tilt-finder, the photogoniometer and the plotting machine. Attention is drawn to the desirability of designing new apparatus with which to carry out the necessary reconstruction with the requisite accuracy.

"**Some Precision Problems in Air Survey,**" by Lieutenant M. Hotine, R.E.

Various problems are considered with regard to cameras for use in the air, for example, the lens and its calibration, the time available for exposure, the construction of a shutter which has to be subjected to sudden alterations of temperature and constant vibration. The factors upon which accuracy in air survey measurements depends are described, and suggestions are made as to some of the conditions which should be fulfilled in apparatus employed for such measurements.

Glass-lined tank lorries are now in use for the bulk transportation of milk to London.

GERMAN OPTICAL GLASS.

According to the *Financial Times* an Interessen-Gemeinschaft agreement covering a long period and a wide field has been concluded between three leading German optical-instrument makers—the Optische Anstalt C.P. Goerz A.-G., Berlin-Zehlendorf; Contessa-Nettel A.-G., Stuttgart, and Ica A.-G., Dresden. The purpose of this move, is stated to be the better utilisation of their means of production and common action in regard to the purchasing of raw materials and semi-manufactured articles.

A fourth-partner, the Ernemann A.-G., Dresden, has since joined hands by the conclusion of a similar agreement with the Ica. The fifth, and probably the leading member of the group—though its name is not actually mentioned as party to the agreement—is the Carl Zeiss concern, of Jena, which, no doubt, was the moving spirit, as it controls the Ica Company and also holds a large number of shares in the C. P. Goerz Company. So far as the Zeiss Company is concerned, the importance of the combine probably lies in the fact that it thus obtains a wider and more assured market for the optical glasses, of which it is one of the biggest makers. In addition to the new connection established by the agreement, the Jena firm has a further valuable ally, the Winkil works in Goettingen.

On the side of the raw material supply another important concern—the Schott Glassworks, in Jena—is also closely connected with the Zeiss group. Consequently, comments the *Financial Times*, the agreement though seemingly concluded between various firms interested in the same stage of production, actually leads, if all the interlacing factors are taken into consideration, to a combine of a far wider range, which includes practically all the various stages of production, from raw material to the highly finished article.

◆

Journal of the British Society of Master Glass Painters, Number 3. Published by the Society, 6, Queen Square, London, W.C.1, 10s. 6d. net.

In publishing this Journal, the Society are not only being of service to their members and others interested in the craft, but are performing an act which will certainly be of inestimable value to future generations who may be interested in this absorbing subject, as they are putting on permanent record the results of investigations and researches by experts into the origin, date, etc. of many of the example of historical stained glass still in existence.

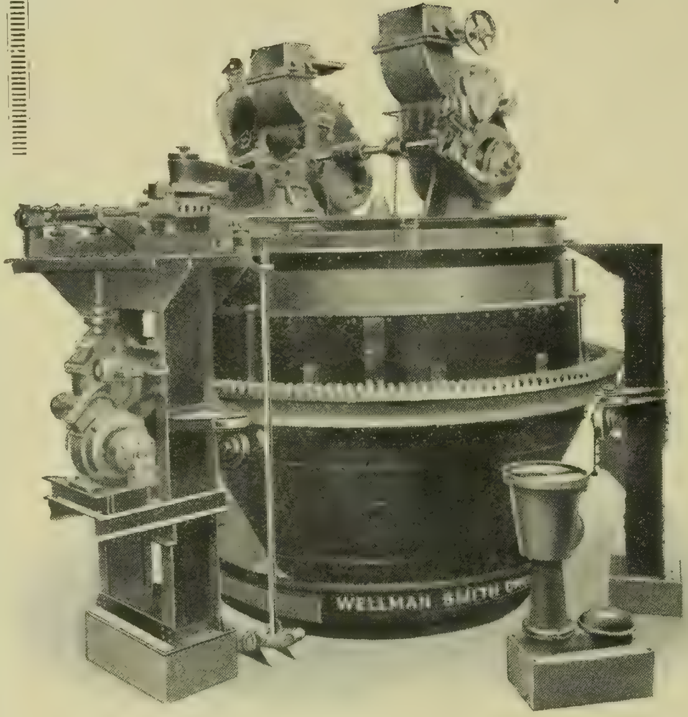
In the number just issued are descriptions of the 12th century medallions at Rivenhall, Essex, and the Italian Annunciation in the Victoria and Albert Museum, as well as articles on the mediæval glass-painter as a copyist, mediæval methods of employing cartons for stained glass, etc., whilst various features of the practical side of the craft are also dealt with. In addition, not the least valuable part is that devoted to a list of recent publications relating to glass painting.

The volume is exceedingly well printed and illustrated and it may be said that the non-initiated will find it extremely interesting reading.

The WELLMAN Type L PRODUCER

WILL

REDUCE
YOUR FUEL
CONSUMPTION



VIEWING the present state of the Glass Trade and the keenness of competition in the home and foreign markets, you cannot but be impressed with the urgency of the need for cuts in the costs of production, and in particular, economy in Fuel Consumption.

That the Wellman Type L Producers are enabling Glass Manufacturers to cope with present-day conditions is amply evidenced by the increasing demand for these machines and repeat orders received. **A repeat order for 7 L Type Producers has just been received from a leading Continental Glass-works, bringing the total number of these machines supplied to this one firm up to 14.** We invite you to write us for full particulars of our Gas Machines, and to allow us to submit data showing how your Fuel Consumption may be reduced.

No. 10 TO GASIFY UP TO 4,000-lbs. COAL PER HOUR.
No. 8 TO GASIFY UP TO 2,600-lbs. COAL PER HOUR.

The WELLMAN SMITH OWEN ENG. CORP. LTD.,

36-38, KINGSWAY, LONDON, W.C.2.
WORKS :: :: DARLASTON, S. STAFFS.

Telephones—HOLBORN 2588/9. *Telegrams*—"PRINCIPIUM, WESTCENT, LONDON."

Some Features of Tank Block Comparisons.*

BY F. S. THOMPSON AND H. I. VORMELKER.

ABSTRACT.

The life of glass blocks can be increased by lower furnace temperature obtained by increasing the area of melting chamber, and by insulation of the walls. Analysis and physical tests of clays and of blocks made from them are compared with results of service test but data does not warrant conclusion.

Introduction.

The glass house men present at the various meetings of the American Ceramic Society during the past year seem to be of the unanimous opinion that better tank blocks for glass furnaces is the most outstanding need of the industry. Some have gone so far as to point out that at the present rate of negative acceleration the life of our tanks will soon be zero.

The question of better refractories is an extremely important one, and the search should be pushed without stint; but we should not overlook the fact that a great many of the vituperations that are heaped upon the heads of the manufacturers of tank materials are not merited. All of these companies are as anxious to produce long service products as we are to receive them and we all know that several of the companies maintain expensive research departments for the purpose of developing the best product from the materials available.

Factories Determining Service Life of Blocks.

It has often been pointed out that the services of any particular tank should be given in tonnage produced per fire and not in total months of fire. It is the fair thing to do; yet, we have great difficulty in overcoming our tendency to compare one fire with another in a given tank by the number of months' duration of each. We have often heard tank men complaining that they are now receiving only eight months' service from a furnace that formerly gave twelve. As a usual thing no mention is made of the increased tonnage.

The life of a tank block is determined by various factors over some of which the tank block manufacturer has no control, such as, the temperature at which the tank is operated, the ratio of tank block surface to the tonnage produced, the design of the tank, and the composition of the glass. The factors which he does control are: the materials, the manner in which they are incorporated and the firing of the blocks. We shall take up each in turn.

Furnace Temperature.

It is a well known fact that a clay substance softens and deforms at a much lower temperature than that required to fuse it completely. This softening point varies in different clays with variation in physical state and kind of minerals present. The temperature of beginning and the temperature range of this softening point have a definite bearing on the wearing ability of a tank block. For example, if a given tank block begins to soften at 1,385°C and a furnace is operated above that point the corrosion will be much more rapid than it would be were the tank operated at a temperature of 1,380°C. Furthermore, disregarding the softening point of clay, we all know that the speed of a chemical reaction is greatly accelerated by increase of temperature. At 100°C clay and glass in contact would remain clay and glass indefinitely, but at 1,800°C there would be, in a few moments, an intersolution. After 1,200°C the acceleration of solution is increased with increase in temperature. Since glass is melted in this rapidly accelerating period, it is a self-evident fact that the furnace should be operated at the lowest temperature consistent with production of the maximum quantity of good product.

Non-uniformity of Temperature in Tank.

It is quite possible that the melting end of a tank could be operated at a temperature but little higher than the refining end if the entire capacity of the space were put to actual use. We know that the bottom portions of the glass move very slowly if at all. We know that glass actually passes through a tank from doghouse to production in one-third the theoretical time. The bottom portion is sluggish because it is viscous and it is viscous because it is cold.

One remedy for this condition has been suggested by Mr. Brownlee of the Buckeye Clay Pot Company. His proposal for insulating the bath of glass tanks has been the basis for several discussions pro and con. Most of the criticisms that we have heard and read are in opposition. Most of them have not mentioned the most important feature that might be expected to result from tank insulation, that is, a lower operating temperature in the melting chamber. We base our assumption of a lower temperature on the increase of useful space made available.

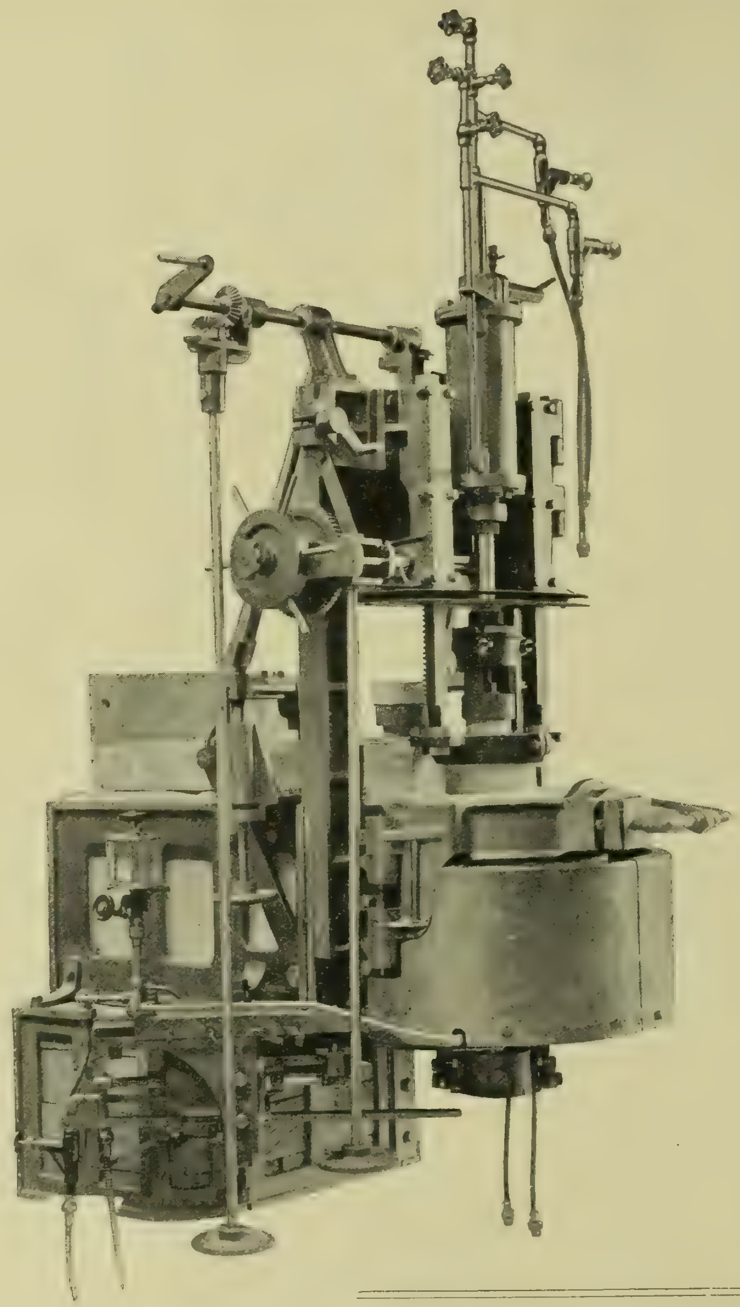
Figure 1 shows a cross-section of a portion of insulated side wall and bottom. In the side wall the dotted line indicates the inside face of the block after several months of firing. This drawing is based on photographs of blocks removed from a tank melting soda-lime glass. If the difference in the degree of corrosion between the top and bottom is due to the difference in temperature it might be possible that with insulation, as shown, the wall would wear down more evenly. The wearing away at the flux line would be retarded by a lower operating temperature and the rate of solution on the lower part of the face would be increased by a higher temperature and more activity in the glass.

Another point that has been overlooked in the criticisms of this theory is the fact that no insulation is placed at or near the metal line. In fact this area should continue to be cooled by artificial means. With this

---

* Presented at the Annual Meeting, American Ceramic Society, Columbus, Ohio, February, 1925. (Glass Division.)

The "RANKIN" Automatic Glass Feeder.



RESULTS JUSTIFY CLAIMS.

Claims without justification are futile.

The need for automatic production is admitted by every glass manufacturer. The question is—what mechanism can be installed with the assurance of the best results?

The "RANKIN" record is unrivalled in the Glass Feeder world. Its history is unique. In no instance has a "RANKIN" installation once installed been superseded. On the contrary, wherever it has been adopted further installations have followed.

The latest proof of this claim is a repeat order for **TWELVE FEEDERS** from a Glass Manufacturing Company, who originally put in one Feeder for comparison with other similar devices. This we believe to be

THE LARGEST INDIVIDUAL ORDER EVER PLACED FOR AUTOMATIC FEEDERS

and represents a great triumph for an All-British Built Feeder.

The mechanism, material and finish are of the highest possible quality. The "RANKIN" Feeder is built for service and will outlast all others.

Demonstrations of the RANKIN AUTOMATIC GLASS FEEDER will be arranged by appointment.

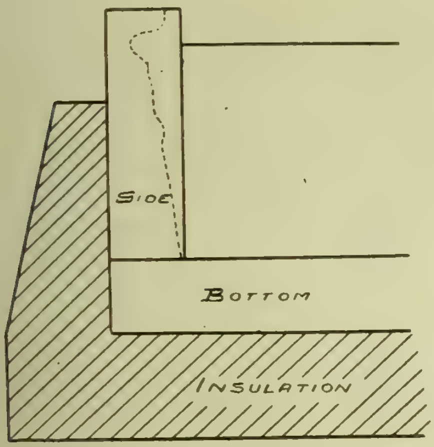
For Illustrations, Descriptive details and terms apply to :

THE RANKIN AUTOMATIC GLASS FEEDER CO.,

1, CHARTERHOUSE STREET, LONDON, E.C.1.

Telegrams : Natiglaso, London.
Telephone Nos. : Holborn, 140 and 141.

arrangement we would have the region of greatest attack, operating as it does to-day with the exception of the advantage of a lower temperature. The lower portions of the side wall and the bottom would, of course, wear away more rapidly but there would be the advantage of the use of a greater volume of the tank capacity.



Ratio of Capacity to Production.

The control of the temperature required in a continuous tank for melting good glass lies largely in the design of the furnace. It is, of course, possible to design a furnace to be used below its rated capacity, but this is not usual nor is it desirable. The increased fuel cost would not justify operating a tank below capacity. It is, however, desirable and economical to use a furnace at its rated capacity but not to overload it. Overloading requires use of increased temperatures with consequent shorter life of the tank. The argument is often advanced that it is economical to overload a tank and overcome the handicap of short life with increased production and lower fuel cost. This may be true in some cases but not a few experiences have proven that this often is an error.

A certain furnace was producing 22.9 tons each twenty-four hours on an average of eight months. This tonnage was produced from a melting area of 296 square feet which is equivalent to 12.9 square feet to each ton. The furnace melting chamber was carried at 1,410°C or higher for the entire run. This temperature was necessary to produce this tonnage of good glass. The coal consumption amounted to 22 tons per day.

At the end of the fire the melting chamber was enlarged to an area of 358.5 sq. ft., an increase of 62.5 sq. ft. With this change the average daily production has been exactly the same as formerly, 22.9 tons per day. But the temperature at the melting end is now 1,350° to 1,360°C (50° lower) and the average daily consumption of coal 19 tons or 3 tons less per day. These comparative figures, based on actual production and operation records, prove that there are times when a large furnace can be operated with less fuel than a smaller one.

Table I

	Melting area.	Tons per day.	Sq. ft. melted area per T melted.	Av. coal per day.	Temp. degrees C.
1st fire	296	229	12.9	22T	1410-1440
2nd fire	358.5	22.9	15.6	19T	1360-1380

It is quite apparent that the furnace blocks will give a far better account of themselves at the lower temperature than at the higher.

Glass Composition.

It is commonly held that the different glasses have different corrosive effects on tank blocks; that is, a given tank might last for fifteen months on one variety of glass and eight months on another. Yet most glass men buy and receive, and most clay works sell and ship, the same block for all glasses. It is our belief that for each glass there is a refractory most suitable and that an effort should be made to determine the character of a refractory most suitable to each type of glass.

Investigation of Clays and Blocks.

In January of 1924 we received sample blocks and a small quantity of the prepared clay with which the blocks were built. We subjected the clay to various physical and chemical tests. The results indicate the wide degree of variation in the raw materials used for tank block construction. Not only were the physical characteristics widely variable but the chemical analyses also showed the products to be indeed markedly distinctive.

Chemical Composition.

The following table gives the silica, alumina and iron oxide content of eight standard blocks that are on the market to-day, and the approximate analysis of the clays, unfired, of which each block was made.

Table II

	Tank block			Unfired clay		
	SiO_2	Al_2O_3	Fe_2O_3	SiO_2	Al_2O_3	Chem. water
1	77.8	21.0	0.7	72.7	20.0	6.7
2	77.4	17.8	2.3	73.4	17.1	5.0
3	76.3	22.0	1.3	71.9	21.0	5.3
4	68.7	27.6	2.6	62.8	25.3	8.6
5	67.3	29.6	2.1	61.1	26.9	8.9
6	63.8	28.2	3.9	...	...	...
7	73.4	22.8	1.8	...	...	...
8	56.5	39.0	2.1	50.1	34.6	11.2

Physical Tests of Clays.

Drying shrinkage of the raw clays also showed a range of differences. To obtain these figures ten bars of 1-inch square cross-section and 6 inches long were made up of equal parts of standard sand and sample clay. Marks were laid off near the ends of the bars with a razor blade and the intervening distance measured. The sample bars were then dried at room temperature and at 120°C and measured again. The following figures show the average shrinkage of each of the clays from which the eight blocks in question are made.

Table III

Clay	Per cent linear shrinkage	Rupture modulus, lbs. per sq. in.	Clay	Per cent. linear shrinkage	Rupture modulus, lbs. per sq. in.
1	1.81	104	5	2.57	140
2	3.48	427	6	2.85	178
3	3.70	258	7	2.45	135
4	2.96	156	8	2.61	187

STEIN & ATKINSON LIMITED,

Telephone
VICTORIA
7325-6.

47, VICTORIA STREET, LONDON, S.W.1.

Telegrams:
METASTEINA,
SOWEST, LONDON.

SPECIALISTS IN GLASS WORKS EQUIPMENT.

GLASS TANKS OF UP-TO-DATE DESIGN INCLUDING TORPEDO TYPE FURNACES BUILT UNDER LICENSE WITH THE UNITED GLASS BOTTLE MANUFACTURERS LTD.

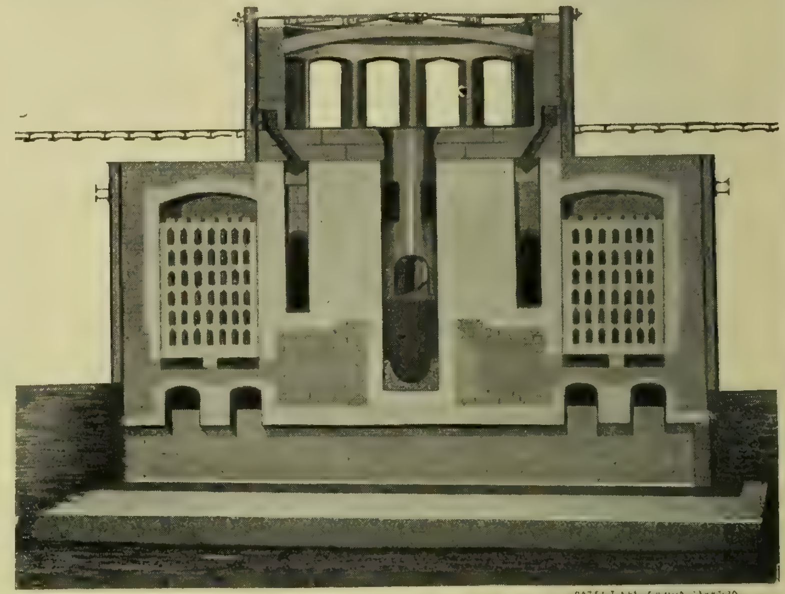
OPEN AND MUFFLE TYPE LEHRS WITH PATENTED DESIGN OF CONVEYOR BELT.

CHIMNEYS AND BINS REINFORCED TILE CONSTRUCTION.

COMPLETE BATCH STORAGE, MIXING AND HANDLING EQUIPMENT.

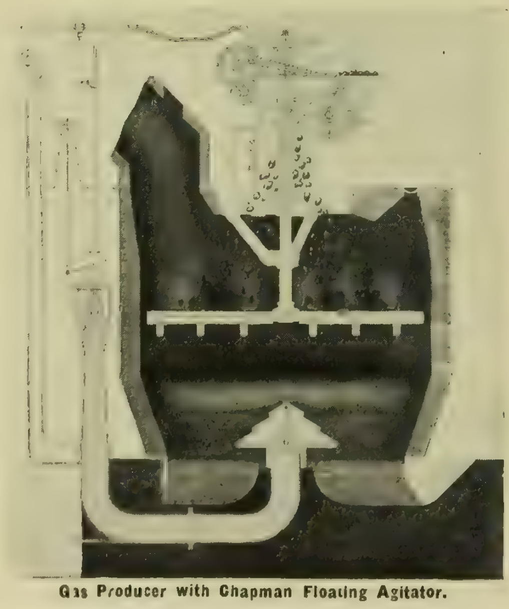
SILICATE OF SODA FURNACES.

CAUSTIC POT SETTINGS.



Cross Section through STEIN PATENTED
POT FURNACE. OVER 100 INSTALLED.

WE ALSO BUILD UNIT POT FURNACES—TWO OR FOUR POTS—STEIN TYPE AND RECUPERATIVE. REVOLVING POT FURNACES FOR OWENS MACHINES.



Gas Producer with Chapman Floating Agitator.

CHAPMAN AGITATORS FOR NEW OR EXISTING GAS PRODUCERS

OVER 1,100 INSTALLED. - 160 IN GREAT BRITAIN.
75% BEING REPEAT ORDERS.

Savings up to :—

COAL ...	25%.
LABOUR ...	75%.

THE CHAPMAN COMPLETELY MECHANICAL PRODUCER.

THE CHEAPEST MECHANICAL PRODUCER ON THE MARKET TO INSTALL AND MAINTAIN IN WORKING CONDITION.

CATALOGUES SENT ON REQUEST.

The modulus of rupture of these same clays was obtained according to the procedure of the American Ceramic Society Standard Test. The bars were 7 inches long and approximately 1 inch square in cross-section. They were composed of equal parts of standard and sample clay.

The question of the effect of the composition of the tank block upon its quality of service naturally arises. It is reasonable to assume that compounds or solid mixtures of different composition will react differently in contact with a definite reagent; that is, we might readily expect that a block containing 77% silica will show a different resistance to corrosion by glass than one containing 50% silica. We might also look for different performances from two blocks containing, respectively, 7 parts of Fe_2O_3 per thousand and 40 parts of Fe_2O_3 per thousand.

Therefore, we might be justified in assuming that these different blocks of varying composition would show different degrees of corrosion in contact with the same glass. If the degree of corrosion is different one must be the greatest and one the least or, in other words, one must be the poorest and one the best in contact with that particular glass.

It would seem, therefore, that a good starting point in the search for better blocks would be the selection, by each manufacturer, of the type of block best suited for his glass from among those already on the market.

We are well aware that it is an unwritten law of the glass house that the only real test of a tank block is to build it into the furnace and find out how long it will last.

This may be the only trustworthy test, but we should not be deterred from seeking other methods of determining the wearing qualities of a block in a few hours or days instead of a few months or years. We are now seeking such a method. We realise that our efforts result in but a very small fraction of the information necessary for a definite conclusion. Satisfactory results will be attained only from a cumulation of data.

Assuming that the greater part of the destruction of the tank block is due to physical abrasion and chemical action between the clay and the glass we set about to obtain some method of comparing tank block solubilities in glass. There are other properties that affect the life service of a block but these two factors seem to be the most important. Inasmuch as porosity has a relation to each of these two properties the figures showing the percentage pore space were determined.

The investigations by R. M. Howe, S. M. Phelps and R. F. Ferguson dealt with the action of slag on various refractory materials. This can be considered a subject closely akin to the one we are discussing.

Solubility Test.

A quantity of chips from the tank block were pulverised in a ball mill and screened. That which passed through the 180-mesh and stayed on the 200-mesh sieve was mixed with a soda-lime glass batch in the proportion of three to one (75% clay—25% batch). This mixture was pressed dry into plaster moulds to form cones the size and shape of Orton Standard cones. The mould and contents were placed in an electric muffle furnace and heated to 650° to frit them into solid form of sufficient strength to permit handling.

Two of these cones were then placed on a pat with a series of Standard Orton cones. The pat was placed in a surface combustion furnace and the temperature raised at the rate of 10° per minute. When the test cones were bent to the pat the gas was turned off and the result noted in terms of Orton cones.

This test is based on the assumption that the cone composed of the mixture the most readily intersoluble would fail first. The results are shown in Table IV.

TABLE IV.

	Solubility				
	Failed at cone	Approx. temp., °C.	Abrasion per cent loss	Per cent. porosity	Apparent density
1	7—	1265	6.2	23.0	2.25
2	6	1250	9.9	23.6	2.24
3	10—	1325	8.4	23.9	2.26
4	12 –	1325	60.1	28.1	2.18
5	6	1255	4.6	23.7	2.23
6	8	1290	16.3	26.5	2.19
7	8	1295	11.6	30.1	2.15
8	14 –	1400	40.1	23.0	2.28

Abrasion Test.

A portion of the sample block was broken up into pieces as near cubical as possible, approximately 1½ inches. Selected pieces were then placed in a ball mill and given a preliminary grinding. This operation ground off the sharp corners and reduced the pieces to a more or less rounded shape. From among these pieces were chosen those of most uniform size and shape.

One hundred and fifty grams of the chosen pieces were placed with 1,000 grams of flint pebbles in an 8-inch ball mill and rotated for a period of two hours at a rate of 80 revolutions per minute. The charge was then removed and placed on a 10-mesh screen and subjected to the action of a Tyler Ro-Tap until nothing remained on the screen but the flint pebbles and the remaining portion of the sample pieces. The latter were removed and weighed and the loss noted. The percentage of this loss gave some idea of the resistibility of the block to abrasive action.

The results of this test on the eight blocks are shown in Table IV.

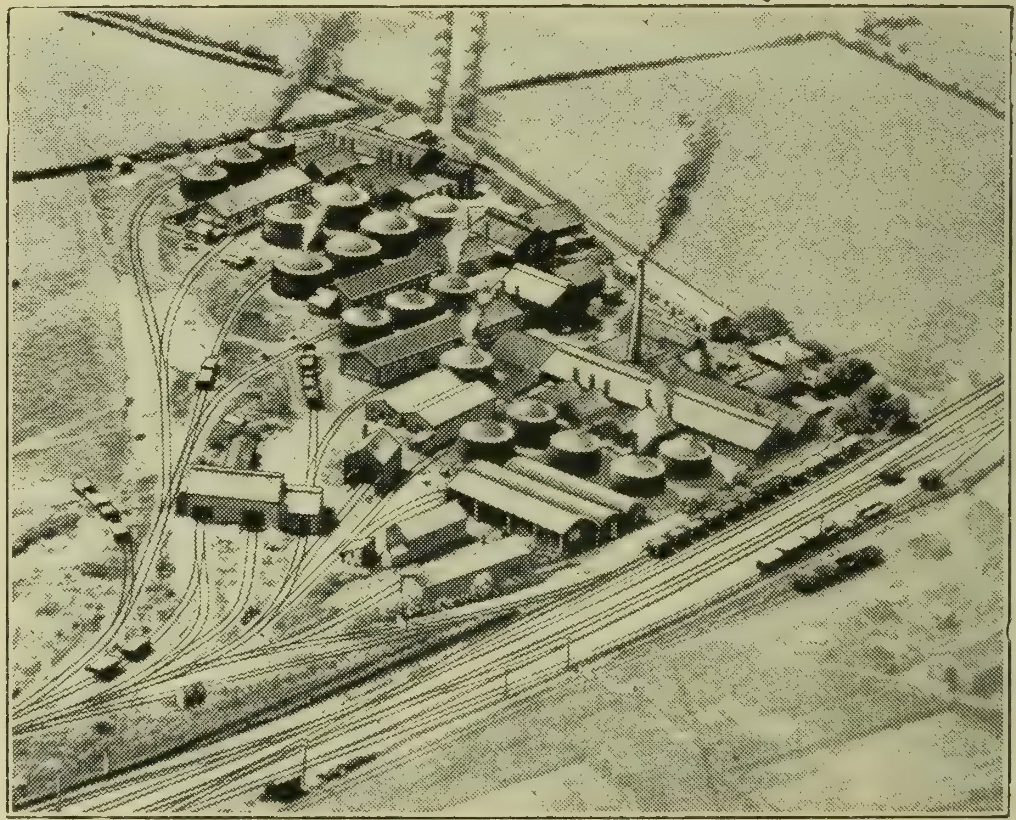
Two samples of English tank block showed porosities of 17.2% and 17.8%, respectively, although they were of porous appearance. On the other hand we examined a clay block and a sillimanite piece that were made and sold as "dense" material. They showed porosities of 30.25% and 39.4%, respectively. Other instances that have come within our observation have indicated that efforts to make a dense block have generally resulted in a higher porosity and, of course, less density. However, if the pores be sufficiently minute the block might be considered as equivalent to one of low porosity even though it measured 40%. The surface tension of the glass would probably be sufficient to prevent penetration.

Such figures as the foregoing obviously are not a complete basis for final conclusions. We have desired merely to point out the marked differences in the principal characteristics of commercial blocks.

THE MOST DURABLE **BRICK**
MADE FOR **GLASS FURNACES.**

STEPHENS SILICA "C"

EXTREMELY REFRACTORY, TOUGH AND DURABLE.



VIEW TAKEN FROM AN AEROPLANE.

Kiln Capacity 1½ Million Bricks. Works Cover over 9 Acres.

SUPER SILICA CEMENT for setting SILICA BRICK.

Used by most of the principal GLASS WORKS.

STEPHENS & CO., KIDWELLY.

The Society of Glass Technology.

The Society's third meeting of the session was held on December 16th at University College, London. Certain business had arisen which necessitated the calling of a Special General Meeting which preceded the Ordinary Meeting.

As mentioned in our report of the Leeds meeting, a sum of money had been offered to the Society by the Glass Research Association, to be devoted mainly to the preparation, by some eminent authority, of a yearly report on the progress made in glass technology. This offer was accepted by the members, and a vote of thanks to the Glass Research Association was passed.

The 85th Ordinary General Meeting.

Two applications for membership came before the meeting, and both were accepted. One of these was from Peru, so the fame of the Society continues to spread, and a new, keen interest such as this should be very heartening to all who have the welfare of the Society at heart.

The two papers presented at this meeting were given by members of the Department of Glass Technology, Sheffield. The first one, by Prof. W. E. S. Turner, D.Sc., was entitled "**The Composition of Glass Suitable for Use with Automatic Machines.**" This paper as stated in the introduction, was intended merely to promote discussion. The changes whch had taken place in the composition of the glasses considered were taken in historical order, first consideration being given to sheet glass.

The percentage chemical composition of window and plate glass had not shown any appreciable deviation from that used all the world over, many years ago. Approxmately, this composition was as follows :—

SiO_2, 72—73% ; CaO, 15—14% ; Na_2O, 13%.

Some attempts had been made, however, to vary this composition, for example, in some cases of the operation of the Fourcault process the CaO had been reduced, and the Na_2O had been increased. This modification had been pushed too far in some instances until the Na_2O content had become excessive, resulting in an unstable, non-durable glass. Again, variation had been achieved in American practice, on the Libbey-Owens machine by the introduction of some 2—3% MgO in place of some CaO.

For the production of electric lamp bulbs no extensive investigations had been made in the composition of glasses operated on machines such as the Westlake. The original soda-lead-oxide-silica glass was still in use, although most firms in America and England now made a soda-magnesia-lime-silica glass, very similar to some bottle glasses very often met with in the United States.

The question of the composition of glasses used in the production of containers or bottles was much wider, since extensive changes had been made in composition. The speaker showed that the Roman glassmakers produced a bottle glass very similar in composition to that used with automatic machines to-day.

English glasses made in the 17th and 18th centuries contained very high percentages of CaO, while volcanic rocks were used in the making of bottles on the continent about 1780.

During the last quarter of the 19th century, in the United States as well as in England, use was made of a glass richer in CaO, and poorer in Na_2O than is usually employed to-day. This practice continued until the War broke out, but has not survived.

Considering very pale green, or colourless bottle glass worked on automatic machines to-day, the speaker showed that very little variation in the SiO_2 content was to be found. This being between 72.5% and 74.5%, the total CaO and MgO contents seldom exceeded 8-9%, and the Na_2O was generally about 16.5%. These figures were cited from actual glass compositions given. The glasses made in this country varied over a much wider range than did those made in the States.

Grave difficulties were immediately encountered when the variation of glass composition was contemplated. Professor Turner stated that four very important factors had to be dealt with, these being :

(1) The actual viscosity of the glass.
(2) The rate at which the viscosity changes with the temperature.
(3) Temperature control of the glass and moulds.
(4) The method of feeding the glass into the machine.

A much wider range of composition could be employed on a suction fed, than on the feeder machines. Again, various oxides have been found useful in widening the limits of composition allowable in bottle glasses, these being MgO, Al_2O_3, MnO, and Fe_2O_3. The first of these made the rate of setting rather more uniform and less rapid than did CaO, but the precise influence which these oxides exerted was not known. General observations, however, tended to show that the presence of some 2-3% MnO made possible an increase in the CaO content. It was quite definite that a higher CaO content could be satisfactorily used in a dark green, or an amber, than in a pale green glass. The speaker pointed out that much could be gained from an investigation of the effect of manganese and iron oxides on the viscosity and emisivity of glasses.

In conclusion, the Professor remarked that one other point could not be omitted from these observations. This was the corrosion of the refractory materials. This had been found to be increased when the soda content of a glass exceeded some 16% ; in fact, the basicity of the mixture appeared to be a very important factor.

The President thanked Professor Turner for his interesting paper, and pointed out that, whereas the gatherer of olden times could adapt his method to meet any changes in the working properties of the glass, no such variation could be met satisfactorily by an automatic machine. Consistent results depended upon constant composition of the glass. As improvements are effected in the design of feeders, so we may expect a wider range of compositions giving satisfactory results, but even then, for any particular machine, constancy of composition will have to be maintained.

Mr. Coad-Pryor was not sure that the Na_2O was responsible for the greater corrosion of refractories. He found that, with a flint, and an amber tank, with the same Na_2O contents of glass, the amber lasted longer than the flint. He was inclined to think that opacity to heat, and also the iron content were determining factors in the life of a tank, and that the iron was responsible for the difference in composition which could be permitted in dark glasses. The thermal conductivity, rather than the emisivity, was of importance. The chief difficulty of the glass technologist lay in the fact that the expert machine man did not know what he really wanted. If only he did, then the properties of the glass could be controlled to meet the needs of the machine.

Mr. Meigh spoke of the experience of successful operation of feeders operating on Pyrex, and an opal glass. Investigation of the possibilities of a machine were necessary. He was surprised at the compositions given, of the old time glasses, and said that we did not wish to revert to them. The investigation of the effect of additions of MgO should, in his opinion, be carried further.

In the course of his reply, Professor Turner mentioned that when melts were made in experimental pots at the same temperature, greater alkali content of the glass produced the greater corrosion.

The second paper, entitled "**The Relationship between the Chemical Composition and the Durability of Glass,**" by Violet Dimbleby, M.Sc., and Prof. W. E. S. Turner, D.Sc., was given by Miss Dimbleby, who introduced the subject by a brief review of the work done previously on the durability of glass. She indicated that there was a great need for a systematic study of the effect on this property, of the various oxides used in glass-making. The method of testing employed in the present work involved the use of glass in the form of powder, and the speaker briefly indicated her reasons for the choice of this method. The powdered glass was of a grain size to pass a sieve of mesh 20, but to remain on mesh 30, the standard sieves of the Institute of Mining and Metallurgy being used. From the values obtained in a series of experiments, it was demonstrated that the same comparative results were reached whether the glass used was in the form of powder, or polished discs. The powder method was the more rapid, and was used throughout the whole of the work described.

Four corroding agents were used, namely, distilled water, hydrochloric acid of constant—boiling strength, 2 N. sodium carbonate, and 2 N caustic soda solution. The powder was carefully examined before use, and any unusual, crazed, or needle-shaped particles were rejected. The tests were carried out using 10 grammes of glass held in a gauze container made of platinum or silver. The water and acid tests were conducted in a silica beaker, the alkali tests in silver. The loose, fine powder was removed from the glass by gentle agitation in alcohol. The rate of boiling, in fact, all conditions of test were kept uniform.

After an hour's boiling the glass was washed in distilled water, dried, and reweighed, the percentage loss in weight being calculated, and the appearance of the residual glass being noted carefully under a lens.

Tests made on Chemical and Bottle Glasses.

Six chemical glasses which are in constant use, and also two satisfactory bottle glasses were tested, in order to gain some idea of the magnitude of the losses in weight obtained from highly durable glasses.

Tests made on Simple Glasses.

Seven series of glasses were made, starting with a soda-silica glass of molecular composition 6 SiO_2 : 2 Na_2O, and the oxides CaO, BaO, MgO, ZnO, Al_2O_3, TiO_2, and ZnO_2 were introduced in definite molecular quantities, at the expense of the soda. A series of soda-silica glasses had also been prepared, but the excessive Al_2O_3 contents, originating from attack of the pots, rendered these samples of no use for comparison.

Two series of soda-boric-oxide-silica glasses were prepared, the first containing approximately 20%, and the second, 10% of Na_2O, the silica being replaced by B_2O_3.

The actual chemical compositions of the glasses had been determined, and the relation between composition and the durability, as measured by percentage loss in weight, was shown graphically. Tables of comparable results were drawn up from which the following conclusions were drawn:—

(1) The Soda-Lime-Silica Glasses.

The replacement of Na_2O by CaO increased the durability of the glasses towards all of the reagents. This effect was most pronounced up to 8 molecules of CaO per 100 molecules SiO_2, then the rate of improvement fell, very little change being effected beyond 12 molecules CaO. The attack by the alkaline solutions was greater than by acid or water.

(2) The Soda-Magnesia-Silica Glasses.

The beneficial effect of the introduction of MgO into the glasses was very marked up to 8 molecules, MgO per 100 molecules SiO_2, then the durability became almost constant at some 12 molecules MgO. The glasses rich in MgO were highly resistant to water and hydrochloric acid.

(3) The Soda-Baryta-Silica Glasses.

The results obtained with these glasses resembled those of the CaO glasses, but in general, the durabilities were inferior. Fair stability was again reached at some 8 or 9 molecules BaO per 100 SiO_2.

(4) The Soda-Zinc Oxide-Silica Glasses.

The relation between percentage loss in weight and ZnO per 100 SiO_2 became practically linear when some 7 molecules of ZnO was reached, the only marked improvement in durability beyond this point being towards NaOH. The higher members of the series were exceedingly resistant to attack by all the reagents.

(5) The Soda-Alumina-Silica Glasses.

The improvement effected by Al_2O_3 was rapid until some 8-9 molecules Al_2O_3 was reached, and the higher members were very resistant to attack by acid, water and sodium carbonate solution. The attack by NaOH appeared to increase slightly, but this was doubtful.

(6) The Soda-Titania-Silica Glasses.

Again, very little improvement was effected in the durability beyond 8 molecules TiO_2 per 100 SiO_2. The resistance to water, acid, and sodium carbonate was very marked, but the behaviour of the glasses towards caustic soda was unsatisfactory.

(7) The Soda-Zirconia-Silica Glasses.

These glasses showed little improvement beyond 4 molecules ZrO_2; they were then very resistant to all of the reagents.

(8) The Soda-Boric Oxide-Silica Glasses.

(a) 20% Na_2O.

A maximum resistance to attack by all reagents was exhibited in this series when the B_2O_3 reached some 8-11%, then, as the B_2O_3 was increased, the resistance fell off rapidly, especially beyond 18% B_2O_3. The losses in HCl became practically constant when the B_2O_3 reached some 30%, and analysis of the solution and residues showed that no SiO_2 was taken into solution by the acid.

(b) 10% Na_2O.

The results obtained from this series were similar to those resulting from the examination of the 20% Na_2O series, but no maximum durability was exhibited. The resistance fell off rapidly beyond about 20% B_2O_3, and numerical results were not possible on the glasses very rich in B_2O_3, in the HCl and NaOH tests, owing to the rapid solution of the glass in NaOH, and to the excessive and sudden swelling in the acid. The percentage losses in weight in HCl became almost constant after 36% B_2O_3, a swollen mass of hydrated silica being left.

In summing up, Miss Dimbleby said that this work emphasised the need for choosing the constituents of a glass so as to arrive at maximum durability towards any particular reagent. She had shown that for resistance to water and hydrochloric acid, zirconia, alumina, zinc oxide, titania, and magnesia were to be recommended, while lime and baryta were not so valuable. Towards attack by sodium carbonate solution, zirconia, zinc oxide, and alumina were very resistant, while titania, lime, magnesia, and barium oxide followed in this order. Resistance to attack by caustic soda was greatest for zirconia, zinc oxide, alumina, lime, baryta, and magnesia.

After thanking the speaker, Mr. Moorshead remarked that the question of durability was one of great importance to all manufacturers.

Mr. B. P. Dudding contributed some very interesting comparative data which he had compiled, particularly relating to boric-oxide—containing glasses. He showed that Al_2O_3 and ZnO were very effective in producing a durable glass, and moreover, he had also found that boric oxide glasses exhibited maximum durability when the B_2O_3 content attained a definite value.

Dr. G. Gehlhoff asked whether the maximum obtained in the B_2O_3 series, by Miss Dimbleby, agreed with that obtained in the physical constants of the glasses. Miss Dimbleby replied that she found the maximum around 8-11% B_2O_3, whereas that found in most of the physical properties occurred at almost 15%.

Mr. Coad-Pryor said that he was inclined to agree that glasses containing BaO were not highly resistant, particularly towards HCl. He also enquired how the glasses were ground for test.

In reply to Mr. W. Butterworth, the temperatures which had been necessary to melt some of the glasses tested, were given as 1450°, or, in some cases, 1500° C. The extensive use of CaO in glasses was due largely to its cheapness, not its beneficial effect on durability as stated by Professor Turner.

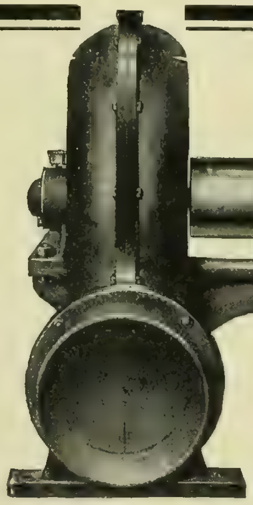
In reply to Mr. Adams it was stated that a difference had been found in the durability of glass surfaces, according to whether or not they had been in contact with a metal surface. For instance the inner surface of a bottle was less durable than the outer, and a fractured surface was less durable than one that was not broken.

The Next Meeting.

The next meeting of the Society is to be held at the Municipal College of Technology, Manchester, on January 20th, 1926. A full programme is assured for the meeting, although the exact nature of the papers to be presented is not to hand.

It is hoped, and appears to be very likely, that a works visit of great interest will be arranged for Thursday, January 21st. If this hope does materialize, a popular and instructive addition will be made to the usual routine of the meeting, and a splendid opportunity will be given for members to enjoy friendly discourse which very often has to be omitted due to lack of time.

V. D.



Don't Cool Your Moulds

with air from your main compressor—but use a Sturtevant Fan. It is more economical and gives ample volume for a small expenditure of power.

Write for our free catalogues, G.L. 1019 and G.L. 1241.

STURTEVANT
ENGINEERING
Co. LTD.
149 QUEEN VICTORIA ST LONDON E.C.4.

NOTICE.

DEFECTS IN GLASS

BY

DR. C. J. PEDDLE, M.B.E., F.I.C.

In response to numerous requests we propose publishing in book form this series of articles They are being entirely re-written with additional illustrations, and the book will be published at a popular price early in 1926.

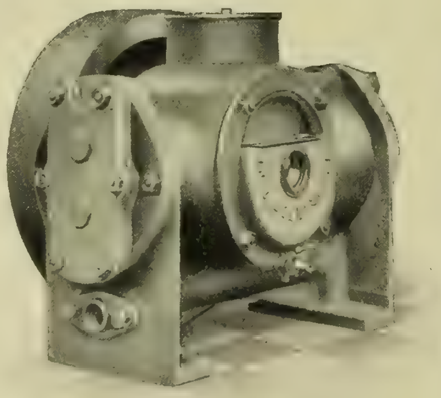
GLASS PUBLICATIONS LTD.,
TALBOT HOUSE,
ARUNDEL STREET, STRAND,
LONDON, W.C.2.

AIR COMPRESSORS & VACUUM PUMPS

As Illustrated in 5 sizes from 10 to 80 cubic feet per minute

Other types Larger sizes

Any Pressure or Vacuum



LACY-HULBERT & CO., LTD.

BOREAS WORKS, BEDDINGTON
NR. CROYDON, SURREY
Telephone : CROYDON 1698.

SILLIMANITE

a neutral refractory material having a definite melting temperature above 3270°F (1800°C).

The December issue of GLASS reported the following expert opinions expressed in papers or discussion at the Leeds Meeting of the SOCIETY OF GLASS TECHNOLOGY :—

Mr. H. H. Houldsworth (of the Fuel Department, Leeds University).

"Experiments made on commercial sillimanite bricks showed that they exhibit very little permanent change in dimensions on heating, their refractoriness is high, and they offer great resistance to attack by soda-lime-silica glass."

Mr. F. G. Clark (of Messrs. Beatson, Clark & Co., Ltd., Sheffield).

"I can testify to the particular resistance to attack of a mixture of about 66⅔ per cent. sillimanite, from experimental data obtained at my works."

Professor W. E. S. Turner (of the Department of Glass Technology, Sheffield University).

"Glass manufacturers seemed to be more keenly interested in the resistance offered to corrosion by glass, by a refractory material, than its ability to withstand unusually high temperatures."

Mr. W. J. Rees (of the Refractories Department, Sheffield University).

"Sillimanite mixtures containing not less than 60% sillimanite were already justifying themselves for purposes where a highly refractory, resistant material was necessary."

P.B. Sillimanite is now available in the raw state, crushed and graded, and in the form of Bricks, Blocks, Shapes, etc.

The P.B. SILLIMANITE
COMPANY, LIMITED,
Sole Agents : PAWLE AND BRELICK.
791, SALISBURY HOUSE,
LONDON WALL, LONDON, E.C.2.
Telephone Number - London Wall 4825.

AUTOMATIC BOTTLES MAKERS' CO., LTD.

On Wednesday, December 23, 1925 a meeting of the creditors of the Automatic Bottles Makers' Company Ltd., Trafford Park, was held in Manchester, when a very unsatisfactory state of affairs was revealed.

As regards creditors the statement showed gross liabilities of £106,527, estimated to rank at £54,230, whilst the deficiency is estimated at £45,230. As regards contributories the deficiency is £178,030. According to the information contained in the Official Receiver's observations, the company was incorporated as a private company on the 17th January, 1923. The original nominal capital was increased from £55,000 to £130,000 on the 9th January, 1925.

The business of bottle making carried on by the company was commenced by Sir W. H. Veno some few years ago and in 1919, a private company known as the Lancashire Automatic Glass Manufacturing Co., Ltd. (authorised capital £400,000), was formed to carry on the business. This, however, was unsuccessful as a Receiver for the debenture holders was appointed and he sold the business to Sir W. H. Veno as and from November 18, 1922, for the sum of £34,000. He in turn resold the business by agreement dated 29th January, 1923, to the present company for £44,500. The increase of £10,500 represented, it was stated, money expended in the business after the 18th November, 1922. The consideration was satisfied by the issue of 54,500 fully paid ordinary shares.

The financial operations of the company were dealt with by the Official Receiver (they are too involved and long to detail here), but in 1924 the company made a trading loss of £51,232, and in 1925 to the 18th August (7½ months) a trading loss of £56,895.

As regards assets these are estimated to realize £10,671 *less* than the amounts due to the debenture holders, so that on this estimate no dividend can be paid to the creditors.

The Chairman of the Company attributes the cause of the failure to "Defective production apparently caused by bad glass and unsatisfactory machines" In this connection the majority will agree with him as regards the bad glass but in view of the results being obtained by other factories with similar equipment to that installed at Trafford Park, the latter part of the chairman's statement, in our opinion, is anything but fair to the suppliers of the machines in question.

If, however, the Company has not been a success in the manufacture of bottles it has achieved it in another direction (although it is one which is no consolation to the creditors), as it's various and numerous operations and changes have provided considerable entertainment and, at times, amusement for the trade.

In his observations the Official Receiver makes a rather significant remark to the effect that he "is of the opinion that further enquiry is necessary in connection with the formation of the Company and the conduct of its affairs." This was confirmed at the meeting by several of the creditors, who, after criticising the board of directors, asked for full enquiries into the working of the company, and appointed a committee of inspection. The Official Receiver was appointed liquidator.

We understand that the meeting was not exactly of an amicable character, several of the creditors present expressing in no uncertain manner, their opinion as to the nature of the enquiry they asked for.

Some rather pertinent questions were also asked with reference to the sales policy adopted by the Company.

◆

SAFEGUARDING OF INDUSTRIES.

The application of the domestic, illuminating, pressed and bulb sections of the glass trade for inclusion under the Safeguarding of Industries Act has been rejected, but it is understood that the Board of Trade contemplates, early this year, a measure to meet the position of those industries which cannot be included under the present Act.

In an interview accorded to a representative of the daily Press, the Financial Secretary of the National Flint Glass Makers' Society said that there were 5,000 keymen in the glass trade and each of these finds work for six or seven others.

He further stated that millions of pounds had been sunk in the trade, and mentioned the case of the British Glass Industries Ltd. This would seem to be a rather unfortunate reference, when it is considered that one of the conditions laid down by the Government is that the industry applying for inclusion under the Act must show that it is run efficiently.

On this page we give details of the Automatic Bottle Makers Ltd., Manchester, and whilst we do not suggest that the results shown by this company and the one just mentioned have had any direct influence on the decision given by the Board of Trade, yet there is not the slightest doubt that they do nothing to assist in establishing a feeling of respect or confidence in the glass industry, on the part of either Government Departments or the investing public.

◆

O'Neill Machines.—It is very interesting to note that the British Glass Bottle Manufactures appreciate the new style O'Neill Automatic Bottle Machines, the following having been sold during the past year:—

1 No. 42 Machine to The United Glass Bottle Manufacturers, Ltd.	in January
1 No. 42 Machine to The Scottish Central Glass Works, Ltd.	,, ,,
2 No. 44 Machines to Forster's Glass Co., Ltd.	in March
2 No. 42 Machines to The United Glass Bottle Manufacturers, Ltd.	,, ,,
1 No. 44 Machine to The Allahabad Glass Works, India	in June
1 No. 42 Machine to The Portland Glass Company, Ltd.	in September
1 No. 42 1 No. 44 2 No. 48 } Machine to Forsters Glass Co., Ltd.	in December
2 No. 48 Machines to Wiegand and Bulle Germany	,, ,,
1 No. 48 Machine to The Allahabad Glass Works, India	,, ,,

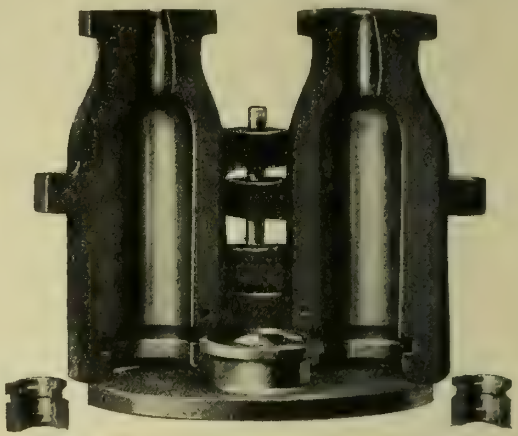
TELEGRAMS:
"GLASMACHIN, ESTRAND, LONDON."
CABLES:
"GLASMACHIN, LONDON."
CODE:
BENTLEY'S.
TELEPHONE:
CENTRAL 5985.

C. SAXTON, A.M.I.E.E., M. IRON AND STEEL INST., Etc.

CONSULTING ENGINEER

Talbot House,
Arundel Street,
Strand, London, W.C.2.

E. LUNN & CO.,
52, MOUNT STREET, GLASGOW.



MAKERS OF MOULDS FOR ALL TYPES OF MACHINES.
All Moulds Made of Solid Closegrained Chilled Iron.
SATISFACTION GUARANTEED.
SPECIALITIES—
LYNCH AND O'NEIL MOULDS

Telegrams: Glasmold, Glasgow. *Telephone: No. 2792.*

TRADE "TWENTY MULE TEAM" MARK
BRAND

BORAX
BORIC ACID
Guaranteed at least 99·50 per cent Pure
BORAX GLASS

GLASS.

Glasses of which Boric Oxide is a constituent have a low co-efficient of expansion, endure rapid changes of temperature, and resist the action of steam, water, and certain chemicals. In glassworks practice the B_2O_3 is introduced by including Borax or Boric Acid in the batch.

These durable glasses are used for laboratory-ware, cooking utensils, illuminating ware, battery jars, miners' lamps, water-gauge tubes, thermometers, insulators, etc. Small quantities of Boric Oxide increase the durability of lead oxide glasses, whilst as an ingredient of container glass it provides resistance to the corrosive action of acid juices and reduces breakages when the charged vessel is heated (as in the instance of preserved meats).

A 40pp. treatise, "*Boric Oxide as a Constituent of Glass,*" gratis on request.

Our Technical Department welcomes correspondence regarding the uses of Borax and Boric Acid in the ENAMELLING, GLASS, and POTTERY Industries.

Telephones ROYAL·1450·2. ROYAL·6683.
Telegrams COLEMANITE, TELEW, LONDON.

BORAX CONSOLIDATED, LIMITED.
16, Eastcheap, *London,* E.C.3.

TRADE NOTES.

The British Industries Fair will be held simultaneously in London and Birmingham from February 15 to 26th, 1926. As on previous occasions glassware will be exhibited at the London section. Full particulars may be obtained from H.M. Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

◆ ◆ ◆

At the thirty-sixth annual meeting of the Leeds Fireclay Co., the Chairman mentioned that £26,410 had been spent during the year on the installation of new plant, the Trade Facilities Department of the Treasury having agreed to guarantee a loan to the Company of £35,000, secured by 5 per cent. second debentures. The profit for the year was £44,032 and the dividends recommended were 7½ per cent. on the Preference and 5½ per cent. on the Ordinary shares, £15,743 being carried forward.

◆ ◆ ◆

A private company, Safetex Glass Ltd. with a capital of £10,500 has been formed to acquire the business of manufacturers of and dealers in non-splinterable glass carried on by Contacto Ltd. The Company also acquires the trade mark " Safetex " and patents Nos. 237,179 and 237,379.

◆ ◆ ◆

The railway companies announce substantial reductions in the charges for the carriage of returned empty boxes or crates, collapsed flat, with sections securely fastened together and not containing other packing materials.

◆ ◆ ◆

Bulletin No. 14 of the Glass Research Association contains a review of the work of the Association 1920-25, and also suggestions with regard to further researches on glass and refractory materials for use in glass making, which in the opinion of the Research Committees of the Association call for immediate investigation.

◆ ◆ ◆

We understand that the co-operative co-partnership scheme started at Castleford some three months ago to take over the Black Flag Glass Works, is making satisfactory progress. Medicine bottles are being made and some hundred men and boys are now employed. Many of the clients of the old firm have returned and it is stated that the company have also got into the export market.

◆ ◆ ◆

According to the Berlin correspondent of the Exchange Telegraph Co. the Carnop Glass Factory has been sold to the Osram Company. This was one of the works financed by the Stinnes interests.

◆ ◆ ◆

The annual report of the Dominion Glass Co., Ltd., Canada for the year ending September 30, 1925, shows a reduction of $146,332 on the figures for the previous year.

We are informed that as and from January 1st, 1926 Messrs. Cazaly, Mills and Co., Ltd., 8 and 9, Byward Street, E.C.3 will be the sole agents in the Thames area for the Fontainebleau sand from the famous Gondonnieres pit of Tisseron Freres and Co., of Rouen.

◆ ◆ ◆

Under the title of Safety Glass and Xetal Products Ltd., a company has been formed and has acquired works at Stapleford, Nottinghamshire. The company will produce, by a patented process, " stabilised " rubber. This is a form of liquid rubber for which many advantages are claimed. At the same time the company claim to have a new process for rendering celluloid completely transparent and are putting on the market an " unsplinterable " glass, consisting of a layer of this specially prepared celluloid between two sheets of glass.

◆ ◆ ◆

The Royal Society of Arts is again holding its Industrial Design Competition full particulars of which can be obtained from the Secretary, John Street, Adelphi, London, W.C.2. In the glassware section the subjects are :—

1. Design for service of glass (wine glass, tumbler and decanter) in plain form or simple decoration.
2. Design for a water jug, goblet and salad bowl suitable for cutting.
3. Design for flower vase or bowl.

◆ ◆ ◆

In order to hasten the modernisation of the Russian glass industries a supplementary expenditure of over 6½ million roubles has been sanctioned.

Considerable progress has been made already both with the bottle plants and also the sheet glass works.

◆ ◆ ◆

Messrs. Pilkington Bros., Ltd. are to erect a staff theatre at their Ravenhead works, St. Helens.

◆ ◆ ◆

Messrs. James A. Jobling and Co., Ltd. (incorporating Greener and Co.), Wear Flint Glass Works, Sunderland, have removed their London office and showroom from 12, Thavies Inn to 7, Charterhouse Street, E.C.1. The telephone number remains the same—Holborn 5329. As and from January 1st Messrs. Jobling will sell their " Pyrex " glassware direct to the trade.

◆ ◆ ◆

A new company known as the Deutsche Libbey-Owens Gesellschaft fuer Machinelle Glasherstellung has been formed to erect a factory at Gelsenkirchen (Germany). The capital of the company is 6 million R.m. and it is proposed to install two furnaces, with two machines to each.

◆ ◆ ◆

The Berlin Correspondent of the Exchange Telegraph Co. states : As all Silesian plate-glass factories are suffering under Belgian and Czecho-Slovakian competition, and sales have decreased considerably recently, they have formed an association of Silesian-Lausitz plate glass factories in Sorau.

Telephone:
ROYAL
4208-9

Telegrams:
KAZMILANKO,
LONDON.

SAND

FOR GLASS MANUFACTURE.

FONTAINEBLEAU. BELGIAN. HOHENBOCKAER.

CAZALY MILLS & Co., Ltd.

beg to announce
that they are now able to offer regular supplies of guaranteed

FINEST QUALITY FONTAINEBLEAU, HOHENBOCKAER & BELGIAN SANDS

as at present supplied to some of the leading Crystal Glass and Bottle Factories in the U. K.

HEAD OFFICE:
8-9 BYWARD St., LONDON, E.C.3.

BRANCHES:
Liverpool, Glasgow, Hull, Southampton.

THE INCANDESCENT HEAT CO., LTD.,

CORNWALL ROAD, SMETHWICK,
BIRMINGHAM.

Telegrams:
Repeat, Birmingham.

Telephone:
Smethwick, 276.

GLASS TANKS, LEHRS, CONTINUOUS KILNS, ETC.,

To operate on Producer Gas, Coal, Coke, Oil or Towns' Gas.

Highest temperatures attained with minimum fuel consumption.

Also GAS PRODUCERS, GAS VALVES, GAS PRESSURE REGULATORS, AND OTHER EQUIPMENT FOR GLASS WORKS.

HEAT AND ACID RESISTING CASTINGS A SPECIALITY.

THE PHYSICAL SOCIETY OF LONDON AND THE OPTICAL SOCIETY. SIXTEENTH ANNUAL EXHIBITION.

The sixteenth annual exhibition of electrical, optical and other physical apparatus, organised jointly by the two Societies was held at the Imperial College of Science, South Kensington from the 5th to the 7th January.

This exhibition is now recognised as being the most important one of the year in so far as new instruments are concerned and 72 commercial firms were showing this year as against 58 last year. In addition there were many non-commercial exhibits which were not the least interesting of the many to be seen.

As is only to be expected, the majority of the instruments and apparatus exhibited were of the laboratory as distinct from the commercial type but there were numerous ones of distinct interest to the glass manufacturer.

Messrs. Adam Hilger Ltd., 24, Rochester Place, Camden Road, London, N.W.10 were showing and demonstrating the Hilger Glass Annealing Testing Bench for the precise determination of the correct temperature at which to anneal glass and various other materials. Its indications are based on the rate of deformation of a strip of glass (or the material in question) of standard dimensions when subjected to a constant stress at selected temperature.

Messrs. George Kent, Ltd., 199, High Holborn, London, W.C.1, had several of their latest instruments for the measurement of the flow of steam, air and gas. Of special interest to the glass manufacturer is their air meter for registering by counter the actual volume of compressed air passing at the temperature and pressure existing at the meter. The meter which is of the shunt gate type is of robust construction and a table of corrective factors supplied with each instrument enables variations in temperature and pressure to be allowed for.

They were also showing a Rotary Steam Meter for use on mains up to 2 in. diameter. This is simple and inexpensive and should be of great value in many works as being a means of obtaining information as to steam consumptions which is usually "guessed at" usually on the low side.

The Foster Instrument Co., Letchworth. This Company had a very complete range of pyrometers on their stand, the majority of which were shown in operation. A new device known as a "Broken Couple" alarm was of particular interest in view of the increasing use of automatic devices for the control of furnace temperatures, whether by means of signal lamps, calling the operator's attention to any variation from the desired temperature in order that he may make the necessary re-adjustment of valves, etc., or by a completely automatic equipment. The new device is to get over the difficulties often encountered with temperature controlling systems, which depend upon the reliability of the thermo-couple in use. Should this latter fail (and they all do so at some time or another irrespective of the make employed) there is a danger of the temperature of the furnace being increased considerably before the failure of the thermocouple is discovered. This is due to the fact that the controlling or signalling equipment will operate in the same way as it would if the furnace temperature falls below the desired point. The "Broken Couple" alarm gives an immediate indication (by electric bell, etc.) that the couple is broken and thus obviates the risk of over heating just mentioned.

Various types of indicators and recorders were shown working; the new "Dial" recorder being interesting as it is of the "inkless" type and is well suited to industrial conditions.

In view of the articles on heat losses from furnace walls that have appeared in this Journal recently, a surface calorimeter for making direct readings of the heat loss—either radiation loss only or total loss, including convection—from furnace walls was of interest. This instrument is simple and portable and was made for H.M. Fuel Research Station to the designs of Capt. A. Blackie.

Messrs. Chance Brothers and Co., Ltd., Glass Works, Smethwick, Birmingham had an excellent exhibit of optical glass in various stages of manufacture. This was the subject of much attention in view of the considerable publicity recently given to the superiority of British optical glass.

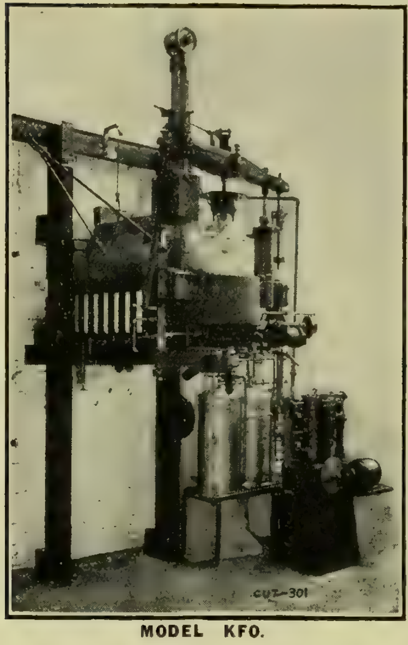
Examples showed the improved quality of Dense Barium Crowns during recent years, whilst 4 specimens were shown to illustrate the varying durability of optical glass. These had each been subjected to steam at 60 lbs. pressure for two hours, with the following results:—

(1) Zinc Crown—absolutely unaffected.
(2) Standard Hard Crown—very fine surface marks.
(3) Extra light Flint (experimental)—the surface is seriously tarnished and corrosion is commencing at any scratches on the surface.
(4) Extra light Flint—so seriously affected as to be absolutely useless.

Further examples showed the effect of devitrification of various optical glasses, the particular constituent that had separated being indicated.

Amongst the non-commercial exhibits we noticed particularly that of the **Research Laboratories of the General Electric Co., Ltd.,** where an apparatus for the comparative determinations of the co-efficient of expansion of glass was exhibited as were also the method of making "glass to silica" joints and large "glass to metal joints." In the former the lead glass end is joined to a hard glass by means of four special glasses. The hard glass is joined to "pyrex" and the free end of the pyrex is heated until it has lost sufficient boric oxide to enable it to join on to silica. The quality of the joints is checked by means of a strain-viewer. In the latter case, the joint is made between lead glass and a nickel-iron alloy the composition of which is adjusted to suit the expansion of the glass used. Before making the joint the nickel-iron is thinly copper-plated and then borated. These joints have been developed for use in valves with water-cooled anodes, for wireless work.

In addition to the exhibits mentioned there were numerous others of interest but space will not allow of their inclusion in this issue.



MODEL KFO.

Latest Miller Feeder

PROGRESSIVELY DEVELOPED SINCE 1907.

By arrangement with the **Morgan Crucible Co., Ltd., Battersea,** a stock of all refractory parts for our feeders is now kept in London.

WILLIAM J. MILLER, Inc., SWISSVALE, PA., U.S.A.
London Office : **366, Strand, London, W.C.2.**
Tel. No.: Regent 5647.
Cables : Autoglasma, Rand, London.
Autoglasma, Pittsburg, Pa.

MOULDS

YOU ARE BOUND to improve the quality and output of your bottles and jars if you use **GOOD MOULDS.**

We supply moulds having the highest possible workmanship and finish. They are produced from the best crucible chilled castings and are machined throughout to precision gauges by practical mouldmakers.

Our service of quick deliveries and guaranteed accuracy in all respects is backed by **LONG PRACTICAL EXPERIENCE.**

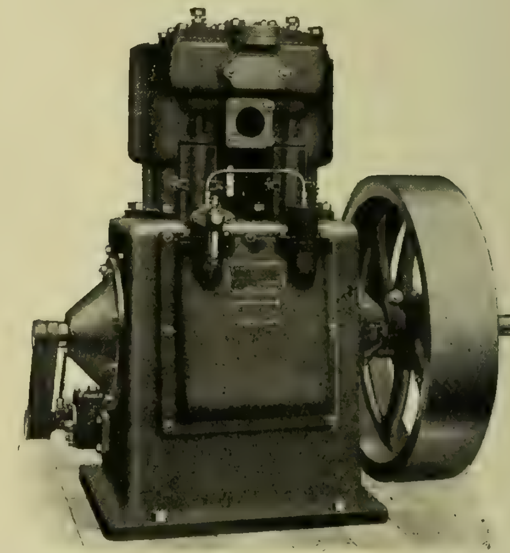
We specialise in mould equipment for **LYNCH, MILLER and O'NEILL** automatic machines but any and all types of moulds are undertaken.

No Order too Large. No Order too Small.

We also supply Glassworks patterns and crucible iron castings of all descriptions.

JOHNSON RADLEY & SONS, Ltd.,
Chesney Works,
Hunslet, Leeds.
Telegrams— MOULDS, LEEDS
Telephone— LEEDS **21354.**

"BROOMWADE"



AIR COMPRESSORS
BRITISH AND BEST
FOR ALL DUTIES.

BROOM & WADE, Ltd., HIGH WYCOMBE.

The Lubrication of Air Compressors.*

One of the first essentials in connection with the satisfactory operation of air compressors is reliable lubrication. It is an unfortunate circumstance, however, that this important feature does not always receive the care and attention it deserves.

It is a well-known fact that many of the troubles encountered in the operation of this class of machine may be traced either directly or indirectly to faulty lubrication. By exercising care, it will be found usually that these troubles can be reduced or eliminated by paying stricter attention to the selection of a suitable lubricant and to its correct application.

Air Cylinder Lubrication. The object of lubrication in an air compressor cylinder is to provide a complete oil film on all frictional surfaces, thereby substituting fluid friction for metallic friction, so far as that is possible, and to form and maintain an oil-sealing film at the working temperatures that will assist in preventing the leakage of air past the piston, piston rings and cylinder walls.

In small and medium sized air compressors oil is introduced sometimes into the flow of air passing through the air inlet pipe, the oil being carried to the cylinder in the form of a spray. Frequently this practice does not give the best results in large compressors, because air is not a good carrying medium for oil, and additional direct feeds to the working surfaces are required.

In horizontal compressors and blowing engines, particularly of large size, oil introduced into the air intake will have difficulty in reaching the upper portion of the cylinder walls, as it arrives there only by slowly wedging its way up and around the sides of the piston. Therefore, to rely only on this method is not economical, owing to the excessive feed of oil required to ensure complete distribution.

In the case of vertical compressors, oil fed into the air intake has a better chance of distribution than in horizontal types; but even so, in special cases, it may be necessary, in addition, to feed oil direct to the working surfaces.

Where it is desirable to feed oil direct, this should be done sparingly and uniformly. In the horizontal types of machines the oil is introduced to one or more points around the cylinder walls. Each point should be fed from a separately controlled pump. In vertical cylinders it is rarely necessary to introduce oil direct to the cylinder walls, except in the case of very large blowing engines. In the latter the oil should be fed to two or more points around the circumference according to the size of the cylinder. Each oil inlet should be fed by an individual pump, so that each feed can be controlled with certainty. If one oil lead be branched to several points, the oil will take the line of least resistance, flooding some points while other parts of the cylinder may be starved.

In any air compressor, it is of the utmost importance that the feed of oil to the cylinders be regulated to the smallest possible quantity consistent with efficient lubrication, in order to avoid the ill-effects of overfeeding. It should be remembered that oil remains in the cylinder of an air compressor for a considerable time because it is not burned away as in the cylinder of an internal combustion engine, nor washed away as in a steam engine cylinder; also we do not get the partial scavenging effect given by the exhaust opening in those engines, and, consequently, a smaller quantity of oil is required. It will be seen, therefore, that it is very desirable to employ an efficient mechanically-operated lubricator that is capable of feeding the oil in closely regulated quantities.

Single-acting trunk pistons may be lubricated by means of splash from the crankcase, or, where a force-feed circulating system to the bearings is in use, by means of oil thrown off from the crank pin.

In a splash-lubricated air compressor it is essential that the oil-level in the crankcase be maintained constant. If the oil-level be too low, insufficient oil will be splashed up, and some of the parts will be starved; on the other hand, with too high an oil-level, there will be too much splash and excess oil will work its way past the piston rings, resulting in the formation of undesirable deposits.

In connection with the lubrication of air cylinders, the purity of the air entering the compressor has a direct influence on its efficiency. It is important that the incoming air be as cool and free from dust and grit as possible. Such impurities will cause trouble, particularly if the oil is being overfed to the cylinders, as they cling to the excess oil and are baked into hard crust-like deposits by the high surrounding temperatures. It is advisable, therefore, to have air screens of ample area fitted to the air intake, and these should be kept scrupulously clean.

Valves. The lubricating requirements of the valves vary with the different types employed.

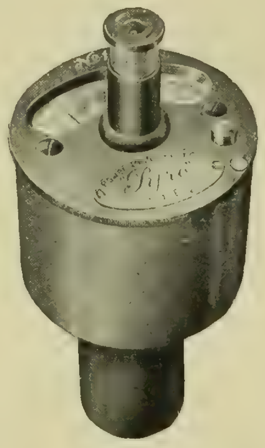
Plate, poppet and automatic spring valves usually get sufficient lubrication from the oil carried by the air, without it being necessary to resort to direct application of the lubricant.

Corliss valves require lubrication on all the rubbing surfaces, particularly at the ends. Oil must be introduced uniformly and as direct as possible. In connection with the practice of fitting grease cups to the ends of Corliss valves, this is not recommended, partly because grease does not spread easily, and partly because there is a tendency for it to bake together with any impurities that may be present in the intake air, forming a pasty, sludgy or varnish-like deposit, some of which may reach the valve chamber or the cylinder, and cause excessive friction and wear.

Bearing Lubrication. The external lubrication of air compressors is similar to that found in steam and internal combustion engine practice, and in all high-speed enclosed types the lubrication of the bearings is

---

* Contributed by the Technical Staff of the Vacuum Oil Company.



Write for our NEW LIST C 32

describing our unique

PYRO RADIATION PYROMETERS

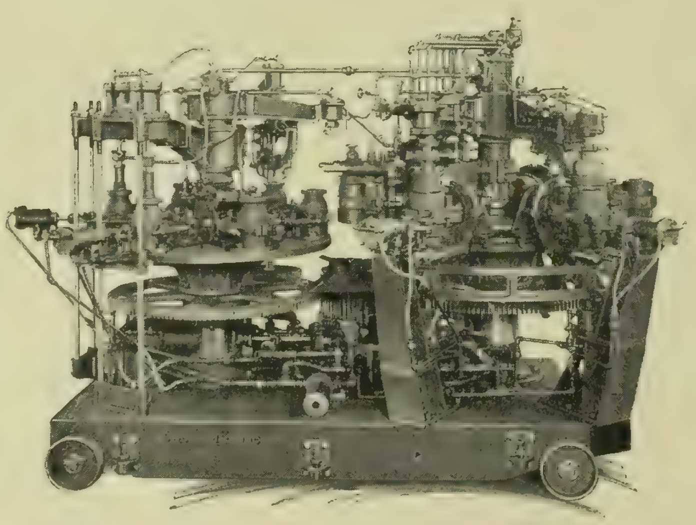
for Indicating or Recording.

Instantaneous, Simple, No Maintenance Cost, Reduced Prices.

BOWEN INSTRUMENT CO.,

9, NEWTON ROAD, LEEDS.

DISTRICT REPRESENTATIVES: R. Gates, A.M.I.E.E., 11, Hill Crest Road, Moseley, BIRMINGHAM.
Jas. Sturrock & Co., 116, Hope Street, GLASGOW.



The New O'Neill No. 44 Blowing Machine.

A well built, high speed blowing machine with a range from 6 oz. to 40 oz. in capacity. Operating speeds up to 23 per minute depending on the class of ware being made. Have our London representative give you the details.

THE O'NEILL MACHINE CO.,

TOLEDO, OHIO, U.S.A.

LONDON OFFICE: 10 SAVOY ST., STRAND, LONDON, W.C.2.

effected by means of splash or by force-feed circulation. On open type machines various methods of lubrication may be employed, such as ring-oiling, drop feed oiling, syphon oiling, mechanical force-feed and hand-oiling.

In splash oiling systems, the oil should be fairly light in body, so as to splash easily to all parts, and yet should be sufficiently heavy to produce complete lubrication. In enclosed type, splash-lubricated air compressors, the same oil must be used for air cylinders and bearings, and, therefore, the requirements of both must be given careful consideration in order to ensure that the oil used will be suitable in both services.

As the oil in force-feed circulating systems is forced in large quantities to the bearings, it is given every assistance to produce complete and correct lubrication The oil must, however, be of such a character as to maintain its nature despite its continuous circulation and the oxidizing effect of air and impurities.

In order to minimize contamination of the oil through the ingress of moisture or other impurities when splash-oiling or force-feed circulating systems are employed, it is good practice, depending on the size of the oiling system and the severity of service, to draw off a certain amount of oil from the system each day for treatment, preferably in a steam heated settling tank, and afterwards in a suitable filter. The purified oil can then be returned to the system mixed with a little fresh oil. This practice is always desirable, particularly where the quantity of oil in use is small, as it ensures that the vitality of the oil is kept at as high a standard as possible, and that the life of the oil is prolonged accordingly.

In big plants, where large quantities of oil have to be handled, this treatment may be effected in one operation by means of a centrifugal separator.

In ring-oiling systems, the bearing surfaces, when operating, are constantly flooded with oil, so that the lubrication becomes as efficient as possible with the grade of oil in use. This class of bearing requires little attention, all that is necessary being to clean the reservoirs periodically and to re-fill them with fresh oil. It is quite common practice to run ring-oiled bearings for as long as twelve months without cleaning out and refilling. If a suitable high-grade oil be used the old oil may be filtered and used over and over again indefinitely as make-up.

Sight-feed drop oilers are in very general use and have the advantage of being readily adjusted, started and stopped. It is necessary to keep the oil-level in the container constant, because the head of oil controls to some extent the rate of feed. Sight-feed drop oilers can be arranged with multiple feeds, each feed being controlled independently, the oil dropping through sight-feeds into oil tubes connected by unions, which guide the oil to the points desired.

By this method of lubrication less oil is wasted than in hand-oiling, and, owing to the better regulation of the feed, the oil film in the bearings is kept more nearly uniform and complete. The lubrication is, therefore, more complete than in the case of hand-oiling, i.e., there is less friction and wear.

Syphon oilers operate by capillarity and are simple and reliable provided proper attention be given to their upkeep. The worsted trimmings should be cleaned of impurities at regular and frequent intervals, otherwise their syphoning capacity will be impaired. The trimmings should be examined periodically to see that they have not become cut or chafed, as this would interfere with the oil feed to the bearings.

The most reliable means of lubrication is by a mechanically-operated lubricator, having a positive, visible oil-feed, and of such construction that it will feed the minimum quantity of oil with regularity and precision. The oil feeds once adjusted should remain absolutely constant, independent of the oil-level in the container and the viscosity of the oil.

Hand-oiling is wasteful and expensive and should be avoided wherever possible.

Explosions. Explosions in air compressor cylinders, receivers and air pipes, have been the subject of much discussion among engineers and operators of compressed air plants. These explosions are brought about by (1) the presence of an explosive mixture, and (2) means of igniting that mixture.

If the cylinder temperature rises sufficiently an excess of lubricating oil will tend to vaporise, and an unsuitable or low quality oil will aggravate this trouble. It is difficult to determine sometimes the cause of an unusual increase in temperature which will bring this about.

The common cause of explosions is air leakage at the delivery valves, allowing hot compressed air to pass back into the air cylinder where it is re-compressed. Any air remaining in the clearance space re-expands and causes only a slight additional rise in temperature of the incoming charge; but if the discharge valves be seated badly, causing considerable leakage past them, the temperature may rise ultimately to a dangerous extent, causing, in an extreme case, the ignition of oil vapour, dust or other impurities in the air. The possibility of an explosion in an air compressor is very remote where there is no accumulation of oily deposits due to overfeeding of the lubricating oil. Therefore, only a suitable high-grade oil which can be fed sparingly should be used.

The heat effect of air leakage past the discharge valves back into the compressor cylinder is cumulative, because the air is of high temperature following previous compression, and its temperature is increased further by each successive compression. High initial temperature is reflected in correspondingly high discharge temperature.

The failure of discharge valves to operate properly may be traced as a rule to one of the following causes: the use of an unsuitable lubricating oil that carbonizes rapidly and causes the valves to stick; the overfeeding of oil, whereby impurities that may be present in the air cling to the excess oil, collect on valve seats and in air passages, and are baked into hard crust-like deposits; fouling of the water jackets in the vicinity of the valves, thereby causing high temperature and distortion due to ineffective cooling.

The main precautions that may be taken to minimize the risk of explosions are:—

(1) The intake air should be as clean and cool as possible.

(2) The lubricating oil must be selected with care, and should be applied sparingly and uniformly.

(3) Intercoolers and aftercoolers should be drained of water and oil and cleaned at regular and frequent intervals.

(4) Efficient cooling of cylinders, including discharge valves chambers, must be maintained. The cooling water should be obtained from a clean source, turned on before starting up, and allowed to circulate for some time after shutting down, in order to prevent scale formation in the water jacket.

(5) Temperature readings of the intake air and discharge air should be taken regularly, as abnormal rise in temperature is a certain indication of trouble.

(6) In order to ensure that cool air shall enter the receiver it is advisable to fit an aftercooler in the discharge line before the receiver.

(7) Readings on the pressure gauges fitted to each stage of multi-stage compressors should be lodged at regular intervals, as variation in the relation of pressures in the various stages is a direct indication that internal, piston ring, valve, or gland leakages are taking place, and that the work is being distributed unevenly. In such an event, investigation should be made immediately and the cause removed. All pressure gauges should be tested at regular intervals, and calibrated with standard gauges.

(8) There should be frequent inspection and cleaning of the water jackets, valves, discharge pipes, coolers and receivers. In multi-stage air compressors, the discharge valves should be examined at least weekly; low pressure valves monthly; receivers and coolers at intervals of from one to six months, dependent upon the severity of the operating conditions.

(9) On no account should paraffin oil be used for the internal cleaning of an air compressor or pipes, as it may evaporate and form an explosive mixture.

(10) When opening up an air compressor, naked lights should not be brought near in any circumstances.

Selection of Oil. The quality and suitability of the lubricating oil used on air compressors, particularly for the internal lubrication of cylinder and valve surfaces, have a direct influence on operating efficiency. Therefore, the lubricant selected should be of the correct body and character.

An oil too light in body will not form a complete oil film, even with a liberal feed, and will cause excessive friction and wear. With such an oil, air leakage past the piston will take place, resulting in abnormal working temperatures and loss of efficiency.

An oil too heavy in body will not spread readily over the rubbing surfaces, and will cause considerable oil drag on the pistons and undue fluid friction.

Oil of inferior quality has to be fed in excessive quantities to form the necessary film. This overfeeding will cause the formation of objectionable deposits.

All open type air compressors are so constructed that an oil chosen specially to suit the air cylinder requirements can be employed and applied quite independently of the oil used for the external moving parts. Generally, in small and medium sized air compressors the oil suitable for the air cylinder lubrication will give satisfactory results on the bearings; but in large sized air compressors special consideration has to be given to the high bearing pressures encountered, which may necessitate the use of an oil of heavier body than that used in the air cylinders.

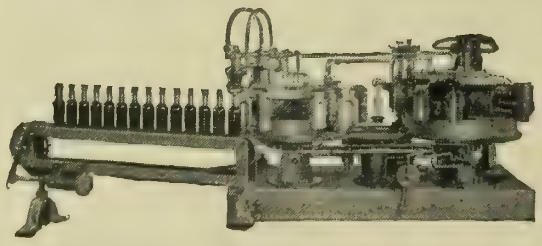
CALENDARS.

We have pleasure in acknowledging the receipt of monthly tear-off wall calendars from the following companies.

The International Construction Company, Ltd., Kingsway, W.C.2. The Miller Machine and Mould Works, Columbus, Ohio. Messrs. Ruston and Hornsby, Ltd., Lincoln, and The O'Neill Machine Company, Toledo, Ohio. We have also received a very useful desk blotting pad provided with diary, a week to a page from Messrs. Parkinson and Spencer, Ltd., Ambler Thorn, Fireclay Works, Halifax.

Glassware Duties.—Cuba.—A Treasury Decree has been issued under which the 30 per cent. tare to be deducted from the gross weight in determining the dutable weight of articles made of crystal and of glass in imitation of crystal imported into Cuba shall henceforward apply only when the containers are cases or barrels of wood, while the 20 per cent. tare will apply when the containers are boxes, etc., made of fibre, cardboard and metal, or consist of crates, baskets, hampers, or other classes of receptacles.—*Reuters Trade Service.*

AUTOMATIC



May be Worked on Floor Level—No Pit Needed

NARROW NECK AND WIDE MOUTH
BOTTLE BLOWING MACHINE
No Transfer Boy. No Take-Out Boy.
STRICTLY AUTOMATIC
When Operated with Mechanical Feeding Device.
Can be Worked by Hand Gatherers. Speed 10 to 32 Bottles per minute, ranging in size from ½ oz. to Gallon
LYNCH GLASS MACHINERY COMPANY,
ANDERSON, INDIANA, U.S.A.
Cable Address—"LYNCHNOBOY" ANDERSON
Codes—A.B.C. 5th EDITION, BENTLEY'S, WESTERN UNION

Legislation Expected in 1926.

(BY OUR CITY CORRESPONDENT.)

In spite of much expectation, and more talk, the net result of commercial legislation in 1925 was (so far as the glass trade is concerned) practically nil. Twice, if not three times, the misfortunes of the British flint glass industry were ventilated in the Press, consequent upon the refusal of the Board of Trade to entertain an application for "Safeguarding." Just before Christmas a prominent paragraph appeared in the *Daily Mail* complaining that in the seven sections of the glass trade only one (the optical section) enjoyed any measure of protection "although unemployment in the other sections ranges from 63% in the domestic to 70% in the plate and window glass sections." This statement was followed by the report of an interview with Mr. William Bradford, the Financial Secretary of the National Flint Glass Makers' Society, in the course of which he is reported to have said:

> "It is the trade unions in the industry which have forced the attention of the Government to the present position, and we are all disheartened at our lack of success. There are 5,000 keymen in the glass trade and each of these finds work for six or seven others.
>
> "The dumping of foreign glass is ruining the industry, and at the present time glass is being imported into this country to be cut by our workmen and then sold as English cut-glass. The manufacturers have done all they can to make the present glass industry, and millions of pounds have been sunk."

The article further reports Mr. Bradford as having cited the case of British Glass Industries, Ltd., with its capital of four and a half million pounds, "the £1 shares of which were quoted on the Stock Exchange in December at 9d. and 9¼d.," and it was said that the Board of Trade contemplates, early in the New Year, a measure to meet the position of those industries which cannot obtain the benefit of the present Safeguarding procedure. I do not know what measure is referred to. On the whole it is regarded in political circles as highly improbable that the Government will press forward the policy of Safeguarding of Industries with very much vigour. The December Debates in Parliament, when the cutlery, glove and gas mantle duties were brought forward, revealed some weakness in the Government's armour. There was, of course, no difficulty in getting the Conservative Party to support the Executive in the Lobby, but in Debate the Government was conspicuously weak, the Opposition parties disclosing a mass of information which left Ministerialists at a disadvantage.

It was also clear that the passage of Safeguarding duties through Parliament is not going to be a simple matter.

A good deal will probably depend on the decision of the Committee which has been examining the woollen and worsted application. If this is turned down, the Safeguarding movement will have received a set-back. If it is granted, we shall be faced with a fiscal departure of great significance, and a tariff crisis might arise.

These things are matters of political conjecture. In certain other respects, however, it is possible to predict with some certainty the first-class legislation which will arise in 1926. Two outstanding questions must be dealt with.

(1) the question of *Merchandise Marks.*

(2) the question of the *Key Industries Duties.*

1. Merchandise Marks. The Government is now pledged up to the hilt to introduce, as a first-class Government measure, a Bill to amend the Merchandise Marks Act of 1887. The limitations of the existing Act have been clearly described in these pages on former occasions. What will the amendments amount to?

There is no doubt that the Industries and Manufactures Department of the Board of Trade is anxious to secure fresh legislation. There has been great pressure from manufacturing organisations and the recommendations of the Imperial Economic Conference have brought the matter to a head.

Two sectional merchandise marks Bills were before the House of Commons in 1925, but both of them were dropped. One was a Private Bill proposing standardised descriptions of certain articles of cheap jewellery. This passed a Second Reading and even survived a stormy passage in Committee, but the Government time table prevented its reaching the Statute Book at the end of the Session. Consequently it lapses. The other Bill was put forward by the Government in connection with the marking of agricultural produce. This was withdrawn, but its withdrawal was made the occasion for an official announcement that a comprehensive Bill would come forward in 1926 to cover, not only agricultural produce, but also manufactures of other descriptions.

The Imperial Economic Conference proposed that there should be three marks recognised by Law, viz.: "imperial," "home" and "foreign." The suggestion to adopt the words "foreign produce" or "foreign made" is intended to overcome the opposition of the entrepot merchants who have always objected strongly to advertising to their overseas buyers the name of the country from which goods have emanated. Why should a London merchant tell his Johannesburg customer that a particular article, which he is selling him, was obtained in Esthonia, Jugoslavia or Montenegro? His business has been built up by ransacking the world for goods that his customers want. I think it very probable that the new Government Bill will recognise the force of this objection, and will accept the words "foreign made" in the place of the words "Made in Germany" etc.

But even so, will universal marking of some kind be made compulsory? It is not compulsory under the existing Act, which merely requires the name of the country of origin to be added to any wording or trade mark which might mislead the purchaser into the belief that the goods were made in Great Britain. The new Bill is certain to go further than this. British Manufacturers urge that in many, if not in all, cases, imported goods should be marked as "imported." The Government may deal with this in one of three ways :

(a) by insisting on universal marking;
(b) by requiring all goods to be marked unless specially exempted by order of the Board of Trade;
(c) by giving the Board of Trade general power to issue lists of goods which must be marked.

In the case of (b) or (c) it might be required that the Board of Trade should accept the advice of investigating committees to whom trade evidence could be presented. Whether there are Committees or not it seems pretty clear that there will have to be some sort of provision for certain exemptions from compulsory marking in the glass trade; for example, it would be necessary to proceed cautiously as to the method of marking required. The problems of glassware marking are very much more complicated than those that relate to pottery. This has always been recognised.

Perhaps at this point I may diverge to refer again to proposals that were put forward last spring by the Executive of the China and Glass Retailers' Association who have been urging on the Pottery Manufacturers the adoption of a corporate trade mark or design, which could be duly registered, and which should be extensively advertised to the public as a guarantee of British manufacture. This proposal was brought to the notice of the Executive of the British Flint Glass Manufacturers' Association who have now written, I am told, to the Retailers' Association to say that they approve in principle of the proposals "although it is felt that in the case of glassware there may be practical difficulties to be overcome with regard to the application of a general mark to articles of glassware." This represents, I am sure, a widespread feeling in the trade.

Before dismissing this matter (until it comes up in Parliament in a concrete form) I may point out that compulsory marking of foreign goods may not prove an unmixed blessing to British Industry. Our great trouble in the glass trade is that such a very large proportion of the goods consumed in this country are of foreign manufacture. In the case of pottery, the facts are exactly the other way.

I imagine that the decision of the Board of Trade not to grant the Safeguarding application was due at least in part to the fact that the British Flint Glass Industry can supply such a relatively small proportion of the glassware required in this country. Therefore, if foreign goods are all marked, the attention of the public will be drawn to the extent and variety of the glassware production of the continent. Some of this, of course, is very cheap, such as the Belgian tumbler, but some of it is both expensive and attractive, such as the higher grade ware of Bohemia. It is unlikely that the importers (*as importers*) would object to the marking of their goods, provided a mark were adopted which would not disfigure the glassware. The importer, as entrepot trader, may have objections; but that is another question.

2. Key Industries Duties. The Safeguarding of Industries Act, 1921, is due to expire on September 30th next. The Depreciated Currency Duties lapsed after three years from the date of the passing of the Act, but the Key Industry Duties were for five years.

It is quite obvious that the Government has to decide without delay its Key Industries policy. In the absence of fresh legislation, there will be no Key Industries Duties after September. Therefore, if anything is to be done Parliament must legislate before it rises for the summer holiday. The Session which runs from February to August will be a very crowded one. A large part of it is mortgaged to the Budget discussions. The Government may decide to provide for the Key Industries Duties in the Finance Bill, which gives effect to the Budget, dating the new duties to operate as from October 1st; on the other hand it may be found more convenient to introduce a Key Industries Bill.

British manufacturers in those sections of industry which enjoy protection under the Key Industries Schedule have been very much concerned for some time past as to the fate of the K.I.D. in 1926. During the recent changes of Government they were alarmed at the uncertainty of their tenure. Under the present Government they are tolerably sure of continued protection. Ministers will have no difficulty in maintaining that when the electoral pledge was given in regard to a general tariff, the safeguarding of key industries was reserved.

Will the present schedule be renewed as it stands? I find that the Board of Trade has been addressing enquiries to manufacturing organisations calling for some statement as to the effect of the past four years' protection. It is very unlikely that any industries which have enjoyed protection will report otherwise than favourably upon it. Naturally, they will want it renewed, if possible. It would seem to be most desirable that some sort of an impartial enquiry should be held. At any rate it seems reasonable to suggest that some sort of an impartial Tribunal ought to review the details of the schedule.

People have short memories, and may have forgotten that the present schedule was rushed through the House of Commons by the Coalition Government with very little discussion, and with practically no examination of detail. On a Second Reading the Schedule was passed by a House of Commons that was generally in favour of assisting basic industries during the difficult period which descended upon us in 1921. Discussion of detail was out of order on the Second Reading. When the Committee Stage was reached the guillotine was used in an unusually drastic way. Only the first two headings of the schedule were dealt with, and the rest was "closured." It seems unreasonable that a schedule which was imposed in this autocratic way at the fag-end of a crowded session in

(*Continued on page* 76.

November Trade Returns.

IMPORTS OF GLASS AND GLASSWARE.

		QUANTITIES.				VALUE.			
		Month ended 30th Nov.		Eleven months ended 30th Nov.		Month ended 30th Nov.		Eleven months ended 30th Nov.	
		1924.	1925.	1924.	1925.	1924.	1925.	1924.	1925.
Scientific Glassware (except Tubing and Rod) ...	value	—	—	—	—	4,244	5,239	59,020	56,992
Glass Tubing and Rod for all purposes	cwts.	184	416	3,973	5,885	802	1,554	15,969	18,903
Illuminating Glassware	,,	16,423	12,529	132,915	140,034	43,947	41,546	359,940	383,326
Machinery Glassware	,,	49	42	371	291	320	305	1,614	2,452
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	54,265	66,213	513,451	552,341	152,958	200,617	1,383,755	1,526,532
Plate and Sheet Glass	,,	108,794	114,207	874,256	1,052,742	167,493	167,513	1,460,717	1,524,185
Optical Glass (other than worked Elements, *e.g.* Lenses)	,,	5	3	49	50	730	398	3,175	3,895
Bottles and Jars	gross	107,443	117,163	1,261,114	1,196,784	72,864	83,025	815,819	753,233
Glass and Glassware not elsewhere specified ...	cwts.	1,709	1,933	13,467	21,552	5,494	6,628	48,158	67,753
Total Value	£	—	—	—	—	448,852	506,825	4,148,167	4,337,271

EXPORTS OF GLASS AND GLASSWARE (BRITISH PRODUCTS).

		QUANTITIES.				VALUE.			
		Month ended 30th Nov.		Eleven months ended 30th Nov.		Month ended 30th Nov.		Eleven months ended 30th Nov.	
		1924.	1925.	1924.	1925.	1924.	1925.	1924.	1925.
Scientific Glassware (except Tubing and Rod) ...	value	—	—	—	—	7,223	5,317	65,964	59,877
Tubing and Rod for all purposes...	cwts.	215	178	2,197	2,911	1,908	1,306	16,711	19,667
Illuminating Glassware	,,	792	642	5,941	5,804	6,887	4,354	52,205	52,850
Machinery Glassware	,,	287	277	4,150	3,907	1,847	1,839	28,192	26,897
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	2,869	2,639	30,580	31,720	26,737	26,310	261,741	296,916
Plate and Sheet	,,	71,120	69,462	732,066	763,918	144,741	130,929	1,495,534	1,437,019
Optical (other than worked Elements, *e.g.* Lenses)	,,	42	6	385	84	1,479	320	8,823	2,348
Bottles and Jars	gross	29,022	24,878	327,745	304,341	30,849	21,668	351,693	300,141
Manufactures, not elsewhere specified	cwts.	811	523	6,823	6,848	4,864	4,057	40,707	42,329
Total Value	£	—	—	—	—	226,535	196,100	2,321,570	2,238,044

EXPORTS OF GLASS AND GLASSWARE (FOREIGN AND COLONIAL MERCHANDISE).

		QUANTITIES.				VALUE.			
		Month ended 30th Nov.		Eleven months ended 30th Nov.		Month ended 30th Nov.		Eleven months ended 30th Nov.	
		1924.	1925.	1924.	1925.	1924.	1925.	1924.	1925.
Scientific Glassware (except Tubing and Rod) ...	value	—	—	—	—	795	618	4,695	5,837
Glass Tubing and Rod for all purposes... ...	cwts.	—	—	4	16	—	7	84	190
Illuminating Glassware	,,	161	255	1,724	1,953	1,799	2,313	12,450	14,717
Machinery Glassware	,,	—	—	—	1	—	2	—	29
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	1,018	1,056	8,432	8,991	6,128	6,357	55,450	56,911
Plate and Sheet	,,	228	333	6,531	2,974	278	310	7,369	3,738
Optical Glass (other than worked Elements, *e.g.* Lenses)	,,	8	—	20	42	162	—	305	312
Bottles and Jars	gross	1,984	3,001	17,412	27,087	2,372	2,726	14,177	23,188
Glass and Glassware not elsewhere specified ...	cwts.	52	10	353	590	432	87	2,768	3,607
Total Value	£	—	—	—	—	11,966	12,420	97,298	108,529

Continued from page 74.

1921 should be automatically renewed five years later in world circumstances which have radically changed.

So far as the glass industry is concerned, the schedule affects scientific and optical glassware and lamp-blown glassware. The last-named item has given rise to tremendous controversy. The term "lamp-blown" glassware appears in the schedule in a strictly scientific context, and was defended in Parliament by arguments that related entirely to highly scientific production. When the Act came to be administered the Customs applied the term to all kinds of cheap-jack articles which happened in fact to be made by the aid of a blow-lamp, but which no one in his senses would connect with Key Industries production. The thing was so manifestly absurd that the Treasury had to make an Order to exempt certain toys and fancy goods where the dutiable part constituted less than 10 per cent. of the value of the article, and also to exempt coloured glassware of a purely ornamental kind, such as Christmas tree decorations. The lamp-blown glassware item (which produced the famous dolls' eyes agitation) afforded a striking instance of the need for careful and discriminating survey of official lists, and it seems inevitable that such a survey shall be undertaken during the next two or three months.

I can give another example of bad effects of hasty legislation.

Certain special glass tubing is imported into this country from Germany for manufacturing into glass phials which are sold in large quantities for colonial markets. The present Act makes no provision for drawback of duty on exportation of these phials. There is provision (complicated, it is true, but nevertheless available) for securing drawback on goods which have paid duty on importation and which are subsequently exported *in the same form*, but the law makes no provision for articles which upon exportation are in a different form from that which they assumed when imported. This is clearly set out in the Board of Trade Customs Notice No. 4. Obviously something should be done about this. I can cite a case of well-known British manufacturers who have spent a great deal on a factory and special plant for converting this imported raw material into goods for export. They have to meet severe competition abroad. German phials imported into this country have to pay Key Industries duty of $33\frac{1}{3}\%$, but when our manufacturers, having imported the tubing from Germany, come to meet German competition in India or Australia, they find that the German competitor has the advantage of shipping direct and escaping the tax on the tubing which the British manufacturer has to pay in order to employ British labour.

This is only one instance of the very unsatisfactory state of our drawback system. Firms who are in the textile trade know the difficulties that have arisen in connection with the silk and lace duties, and if there is to be any extension of our present tariff system, the authorities will have to give very serious attention to the drawback question. I shall have to deal with this subject in a special article as opportunity arises. It involves the whole question of bonded warehouses and free port areas. I merely refer to the matter here because it is one which ought to be ventilated while the renewal of the Key Industries Duties is under consideration.

Straw Packing. The trade was seriously inconvenienced during the Christmas season by the sudden publication of a Ministry of Agriculture Order prohibiting the transit of packing straw otherwise than as actual packing for accompanying goods. This meant that the railway companies promptly refused to accept empty crates with straw for return to works. The Order came, unfortunately, at a time when distributors were receiving extensively large consignments into warehouses and showrooms, and were naturally anxious to get rid of their packing materials as soon as the goods were unpacked. If house room could not be found for the straw there was no option but to burn it, and this meant substantial loss to the trader. The Order of the Ministry was the result of fresh outbreaks of foot and mouth disease reported from several areas in the country. At the time of writing it is uncertain whether a solution will be found so long as the Order continues.

The carrying companies have made certain representations to the Department. If these are not accepted manufacturers will certainly be pressed to make arrangements for sterilisation acceptable to the authorities, or else to use some alternative packing material, such as is already used for export consignments to the Irish Free State, where prohibition of straw has been in force a long time.

AUSTRALIAN GLASS TRADE.

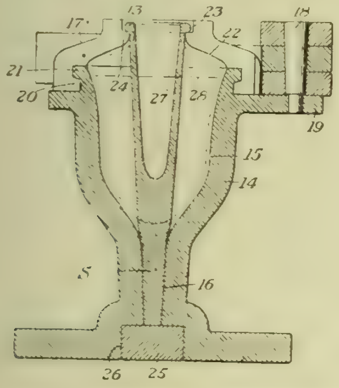
The following remarks are an extract from the D. O. T. "Report on the Economic and Commercial situation of Australia to June, 1925," just issued by H.M. Stationery Office (2s. net.).

"In plate and sheet glass, and especially the latter, Belgium is a very keen competitor with the United Kingdom; in fact, her trade in both classes in 1923-24 was greater than the trade of the United Kingdom, in sheet glass considerably greater. This success is due entirely to cheaper prices and, under present conditions, appears to be unavoidable. Australia now produces a large proportion of the bottles required for home consumption and also a certain amount of pressed glassware. The imports of general glassware in 1923-24 however, amounted in value to £488,996. The better class trade is almost entirely from the United Kingdom, but in the cheaper trade there is considerable competition from Belgium, Czecho-slovakia and Japan. Cheap tumblers are imported very largely from Belgium and electric light shades from Czecho-slovakia. The United States have built up quite a considerable business in lighting glassware and glassware for cooking, the American product in the latter line having a better general appearance than the British. The following figures show the value of the imports of glassware from the leading competing countries in 1923-24:—United Kingdom, £149,711; Belgium, £34,929; Czecho-slovakia, £38,024; Germany, £15,178; Japan, £76,850; U.S.A., £148,168; other countries, £26,136. Total, £488,996.

United States Patents.

GRANTED NOVEMBER 10, 1925.

1,560,784.—**Manufacture of Glassware.** De Witt C. Hamilton, Sapulpa, Okla., assignor to The Bartlett-Collins Glass Company, Sapulpa, Okla., a Corporation of Oklahoma. Filed July 16, 1924. Serial No. 726,307. 4 Claims. (Cl. 49—80.)



1. The method of making a stemmed article of glassware, comprising placing a charge of molten glass in the cavity of a blank forming mould, inserting a plunger into said cavity to form the bowl portion of the blank having an integral stem depending therefrom, withdrawing the plunger, removing the blank from the forming mould and placing it in a one-piece blowing mould, and blowing the bowl portion of the blank into the desired form, substantially as described.

1,560,569.—**Metal Cap or Closure.** Charles Hammer, Hollis Court Boulevard, Queens County, N.Y. Filed February 2, 1925. Serial No. 6,196. 4 Claims. (Cl. 215—44.)

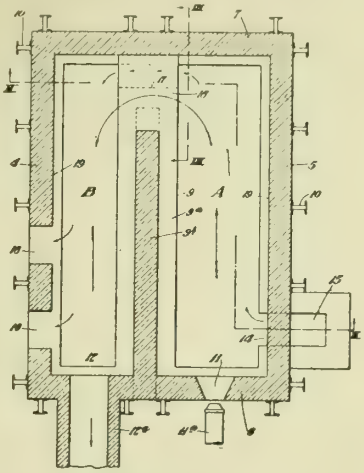
1. A metal closure for glass containers, comprising a top having a depending skirt provided with a beaded or curled lower edge flattened or pressed upwardly and inwardly to form a relatively long inwardly extending locking lug having its inner face inclined to the top of the cap.

1,561,107.—**Lens-Grinding Machine.** Harold K. Parsons, Southbridge, Mass., assignor to American Optical Company, Southbridge, Mass., a Voluntary Association of Massachusetts. Filed July 1, 1921. Serial No. 481,812. 2 Claims. (Cl. 51—133.)

1. A machine for grinding multifocal lenses comprising a tool provided with a central recess on its surfacing face, a spindle concentrically mounted for rotation above the tool, a sun gear secured adjacent the lower end of the spindle, an adjustable bracket arm secured to the lower end of the spindle, the length of said bracket arm being less than the radius of the recess in the tool, a work holder mounted for rotation in the bracket arm, and a pinion secured to the work holder shafe and meshing with the sun gear.

1,561,393.—**Melting Furnace.** William A. Yung, Pittsburgh, Pa. Filed April 15, 1925. Serial No. 23,289. 7 Claims. (Cl. 263—39.)

7. In a glass melting furnace comprising a rectangular body portion composed of a bottom wall, side walls, front and back end walls and roof, a dividing wall extending longitudinally of said furnace from end to end and bottom to roof forming two chambers, openings through said dividing wall adjacent one end for the passage of glass and the products of combustion from one chamber to the other, said side walls being offset outwardly intermediate their upper and lower edges and said dividing wall being materially thicker from its bottom upwardly to a point intermediate the bottom and roof of said furnace to thereby form relatively narrow flow paths for the molten glass and relatively wider flow paths for the products of combustion above the glass, and means for cooling the thicker portion of said dividing wall.



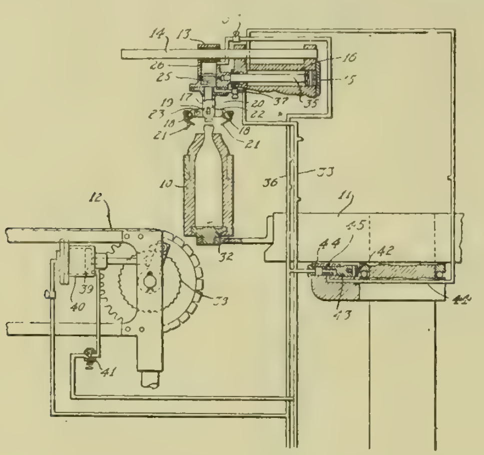
1,561,397.—**Ornamental Glassware and Method of Making the same.** Jacob Bass, New York, N. Y., assignor to E. & J. Bass, Inc., a Corporation of New York. Filed May 2, 1925. Serial No. 27,467. 7 Claims. (Cl. 41—34.)

4. The method of mounting glass jewels, or the like, on an article of glassware, which comprises, electro-plating a layer of metal into the glass, soldering a metallic object having a jewel recess, onto the layer of metal, electro-plating the object and layer to conceal the solder, and fastening the jewel into the recess.

1,561,431.—**Band-Lug Closure.** Charles Hammer, Queens, N. Y., assignor to American Metal Cap Company, Brooklyn, N. Y., a Corporation of New York. Filed January 19, 1922. Serial No. 530,267. 8 Claims. (Cl. 215—44.)

1. A combined rotatable and reusable metal cap and sealing band, said cap comprising a top having a depending skirt provided with a strengthened, curled or beaded lower edge, and inwardly extending locking projections, said sealing band extending below said skirt and having its top and bottom portions bent inwardly, the former to directly engage the strengthened edge of the cap and the latter to engage under the shoulder of the container, the sealing band and cap so co-operating that the sealing band forms the first locking means for the cap without the rotation thereof while the projections of the cap form the second locking means on the removal of the band.

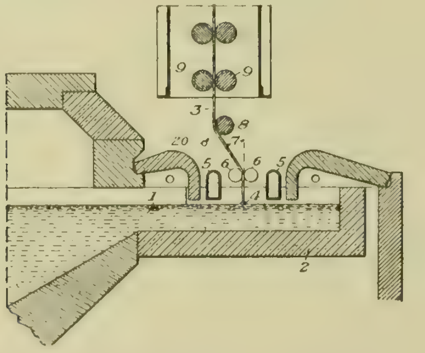
1,561,451.—**Take-out Device for Bottle-Blowing Machines.** James W. Lynch, Alexandria, Ind., assignor to Lynch Glass Machinery Company, Anderson, Ind., a Corporation of Indiana. Filed March 2, 1922. Serial No. 540,538. 30 Claims. (Cl. 198—22.)



1. In a glass working machine, a movable table and series of moulds carried thereby, means for opening said moulds at a predetermined point in their movement, a conveyor adjacent said point, and a take-out device for transferring glass ware from said moulds at said point to said conveyor, said take-out device comprising a laterally movable carrier, a vertically movable yoke mounted thereon, and arms carrying grippers at their outer ends pivotally connected to said carrier intermediate their ends and to said yoke at their ends remote from the grippers, said pivotal connections having limited freedom of movement whereby raising said yoke first swings and then elevates said grippers, and continuously acting means for restraining said grippers against lifting movement until the gripping action is completed.

GRANTED NOVEMBER 17, 1925.

1,561,478.—**Drawing and Flattening Sheet Glass.** William L. Monro, Pittsburgh, Pa., assignor to Window Glass Machine Company, Pittsburgh, Pa., a Corporation of New Jersey. Filed August 15, 1924. Serial No. 732,171. 14 Claims. (Cl. 49—17.)



1. The method of drawing and flattening a single sheet of glass, which comprises drawing the sheet vertically from a bath of molten glass, and then deflecting the sheet from the vertical through an angle materially less than a right angle by passing it against a flattening roller, substantially as described.

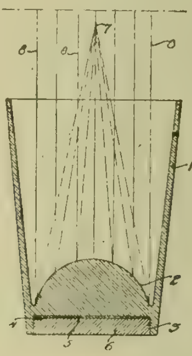
1,561,571.—**Plastic Fire Brick.** William A. L. Schaefer, Chicago, Ill., assignor to Plibrico Jointless Firebrick Company, Chicago, Ill., a Corporation of Illinois. Filed April 9, 1919. Serial No. 288,745. 2 Claims. (Cl. 106—10.)

1. A plastic fire-brick comprising a clay rich in alumina apportioned into raw and calcined parts in the proportion of nine and two mixed together and with ground burner fire-brick in the proportion of eleven and eighteen.

1,561,641.—**Refractory Composition.** William A. Farish, Brooklyn, N. Y. Filed May 31, 1918. Serial No. 237,403. 5 Claims. (Cl. 106—9.)

1. A non-recrystallised refractory composition, consisting of a refractory, electric furnace product, a carbonizing binder, and borax.

1,561,730. **Drinking Glass.** Isami Kodama, Meadow Brook, Pa. Filed March 24, 1924. Serial No. 701,326. 5 Claims. (Cl. 272—8.)



1. A drinking glass having a perceptible object secured to its flat outer bottom face and having its inner bottom face substantially curved whereby the object is invisible or unrecognisable to one looking into the empty glass but clearly visible to one looking into the glass when filled or partly filled with a transparent liquid.

1,561,860.—**Optical Instrument and Lens.** Joseph J. Kennebeck, Kansas City, Mo. Filed July 27, 1922. Serial No. 577,910. 9 Claims. (Cl. 88—57.)

1. A guide having an aperture, a pair of duplicate lenses mounted in said guide, said lenses and aperture being so adjustably related that the combined power of the lenses when viewed through the aperture can be varied in one sign only from plano to the initial power of the lenses.

1,562,068.—**Grinding and Polishing Apparatus.** William Taylor, Leicester, England. Filed April 9, 1918. Serial No. 227,563. 28 Claims. (Cl. 51—119.)

1. Apparatus for grinding and polishing spherically curved surfaces, comprising a pair of co-acting work and tool members, one having a convex and the other a concave surface, means for imparting a concentric rotary movement to one of said members, means for moving the other of said members bodily in a circular path about an axis which intersects the axis of rotation of the first said member substantially at the common centre of curvature of the surfaces of the two co-acting

members, and means for applying to the member which is moved bodily a force in a direction at an angle to the axis of the movement of said member and substantially toward the centre of curvature of the co-acting member.

3. Apparatus for grinding and polishing spherically curved surfaces, comprising a pair of coacting work and tool members, one having a convex and the other a concave surface, means for imparting a concentric rotary movement to one of said members, and means for moving the other of said members bodily in an eccentric path on and about the surface of the first mentioned member, said moving means including a device adapted to engage and move the said member and being adjustable along a line radial to the common centre of curvature of the two coacting members.

1,562,115.—**Silica Glass.** Levi B. Miller, Lynn, Mass., assignor to General Electric Company, a Corporation of New York. Original application filed April 1, 1921, Serial No. 457,660. Divided and this application filed February 13, 1923. Serial No. 618,859. 6 Claims. (Cl. 49—14.)

1. An electric furnace adapted for shaping plastic silica which comprises a container providing vertical heating zone having a discharge port located at its lower end, an electric heater therefor, a refractory crucible supported in said heating zone and having a die aligned with said discharge port to permit of the extrusion of material therethrough and means for extruding a charge from said refractory container.

1,562,341.—**Method of and Apparatus for Glazing and Polishing Glassware.** Albert Breakenridge Knight, Fairmont, W. Va. Filed December 13, 1923. Serial No. 680,519. 8 Claims. (Cl. 49—58.)

1. The herein described method of polishing and glazing glassware which consists in subjecting the ware to the action of a polishing burner, lowering the temperature of the ware, and subjecting it to the action of a glazing burner.

1,562,342.—**Glass-Working Burner.** Albert Breakenridge Knight, Fairmont, W. Va. Filed December 17, 1923. Serial No. 681,232. 4 Claims. (Cl. 49—58.)

1. A device of the character described comprising a substantially fan shaped casing divided to form a plurality of substantially fan shaped mixing chambers having a common wall at their outer ends, said wall being provided with a plurality of sets of burner nozzles each set communicating with one of said chambers, means for conveying articles of glassware progressively past said nozzles, means for supplying fuel to said chambers, and means for independently controlling the flow of fuel to said chambers whereby heat areas of progressively increasing intensity are provided adjacent said nozzles in the path of travel of the glassware.

1,562,350. **Nonfogging, Nonfrosting Double-Lens Goggles.** George P. Luckey, Dayton, Ohio. Filed July 15, 1922. Serial No. 575,408. 5 Claims. (Cl. 2—14.)

1. A double lens goggle having an air space therebetween, said lenses being sealed from the exterior and an air vent communicating between the outside and the space between said lenses.

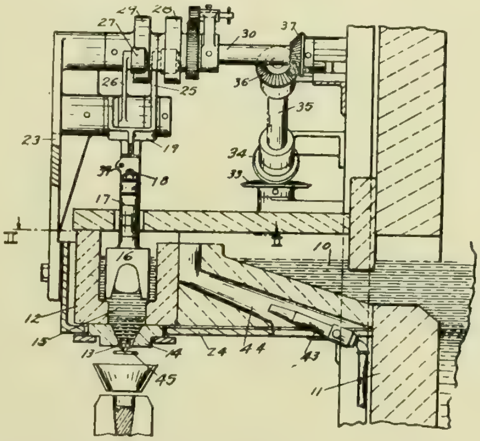
1,562,378.—**Method of Manufacturing Bifocal Lenses.** Harold J. Stead, Geneva, N. Y. Filed February 21, 1922. Serial No. 538,174. 3 Claims. (Cl. 49—79.)

1. In the process of manufacturing multifocal lenses, moulding a groove in a piece of glass, utilizing the groove forming portion of said mould as a filler for said groove, and then grinding the glass to form an optical surface thereon.

2. In the process of manufacturing multifocal lens blanks, moulding a groove in a piece of glass, securing a ring of different material in said groove, and grinding visual surfaces upon opposite sides of said ring.

GRANTED NOVEMBER 24, 1925.

1,563,298.—**Apparatus for Feeding Molten Glass.** Leonard D. Soubier, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Filed May 17, 1923. Serial No. 639,607. 11 Claims. (Cl. 49—55.)



2. A glass feeder comprising, in combination, a receptacle to contain molten glass and provided with a discharge orifice, and means controlling the discharge of glass through said orifice comprising mechanical members within the glass adjacent to the orifice, and automatic means for periodically moving said members toward and from each other in a direction transverse to the direction of movement of glass through the orifice, said members when moved toward each other serving to substantially cut off the flow toward said orifice.

1,563,018.—**Mirror.** George F. Colbert and William H. Colbert, Pittsburgh, Pa. Filed September 13, 1921. Serial No. 500,290. 1 Claim. (Cl. 88—1.)

A mirror for use on automobiles and for similar purposes consisting of sheet glass having a reflecting coating on its rear surface and a protective backing of waterproof sheet material applied to the said reflecting surface by means of a waterproof adhesive.

1,562,587.—**Device for Grinding Bottles and Stoppers.** William H. Ranagan, Vineland, N. J. Filed August 8, 1924. Serial No. 730,804. 3 Claims. (Cl. 51—181.)

3. A pair of grinding plates for a tool of the type described which comprises a pair of sheets forming a frustro-conical surface and adapted to be mounted respectively on their inner or their outer surfaces.

BRITISH PATENTS.

The following abstracts are taken from the Illustrated Official Journal of Patents with the special permission of the Controller of H.M. Stationery Office.

Printed copies of the full specifications can be obtained from the Patent Office 25, Southampton Buildings, London, W.C. price 1/- each.

241,180.—**Glass manufacture.** Naamlooze Vennootschap Internationaal Octrooibureau, 6, Emmasingel, Eindhoven, Holland. September 25, 1925, No. 23995. Convention date, October 8, 1924. Not yet accepted. Abridged as open to inspection under Section 91 of the Act. (Class 56.)

FIG.2.

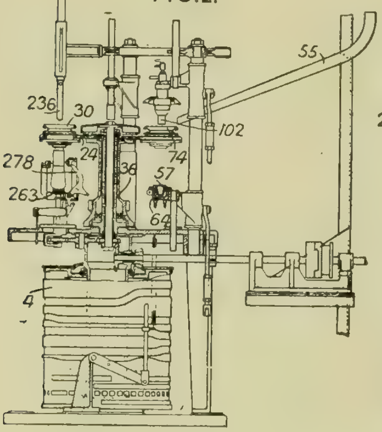


FIG.1.

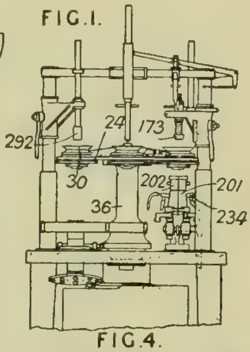
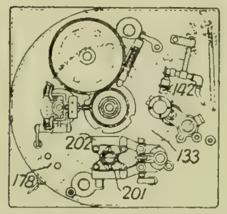


FIG.4.



Blowing.—An automatic machine for blowing glassware, particularly electric lamp bulbs, comprises a pressing-plunger and a press mould for forming the parisons, a finishing mould, and a number of ring or head moulds for conveying the parisons from the press mould to the finishing mould. Means are provided for reheating the parisons after they have been formed by pressing, for turning the parisons while they are being blown in the blowing-mould, and for burning off the finished bulbs from the surplus glass by which they are supported by the ring moulds. The machine comprises a central vertical column 36 to which a table 24 is secured, four ring moulds 30 being mounted on the table in such a manner that they are rotated at appropriate times. The column 36 is rotated intermittently so that each ring mould is carried in turn to one of four operating stations. At the first station a mould 57, which is cooled by the circulation of water through a jacket 64, is raised into contact with the underside of the ring mould. A charge of metal from a feeder is guided into the mould by means of a shoot 55 and a funnel 74 which form the upper part of the ring mould. A plunger 102 then descends and presses the metal in the mould to form a parison. The mould is next lowered and puffs of air, supplied by a cylinder 133, Fig. 4, enter the parison through channels in the side of the pressing-plunger and blow it partly. The ring mould rotates and a burner 142 is swung into position so that its flames play upon, and reheat, the rotating parison. The plunger rises out of the parison mould and the table 24 is moved to convey the parison to the next station, the burner swinging out of the way as the table moves. At this station the parison mould is enclosed by the two halves 201,202, Fig. 1, of the blowing-mould. The mould halves are cooled by water circulated through channels in their body, and the paste with which their inner surface is coated is moistened by water sprayed from nozzles 234. Air for blowing the bulb is supplied by a cylinder 178, Fig, 4, and is applied by a blowhead 173, Fig. 1, which is lowered into the upper part of the ring mould. After the blowing is completed, the head 173 is raised and the table 24 moves to convey the bulb to the next station where it is detached from the "lost head" a neck of glass which is held by the ring mould. For this purpose, a burner 236, Fig. 2, is lowered through the ring mould into the interior of the bulb and directs a sharp flame against the inner wall of the neck. As the bulb rotates, the glass is fused along a narrow circumferential zone. During this operation, the bulb is supported by a seat 263, and when the fusion of the glass is completed, the bulb is detached and is ejected from the machine by a forked lever 278. The movement of the table carries the ring mould beneath a plunger 292, Fig. 1, which descends into the ring mould and detaches the "lost head" of glass, the parts of the mould having been opened. The operations of the different parts of the machine are controlled by cam tracks on a rotating drum 4.

241,182.—**Glass manufacture.** Naamlooze Vennootschap Internationaal Octrooibureau, 6, Emmasingel, Eindhoven, Holland. September 29, 1925, No. 24225. Convention date, October 9, 1924. Not yet accepted. Abridged as open to inspection under Section 91 of the Act. (Class 56.)

FIG.2′

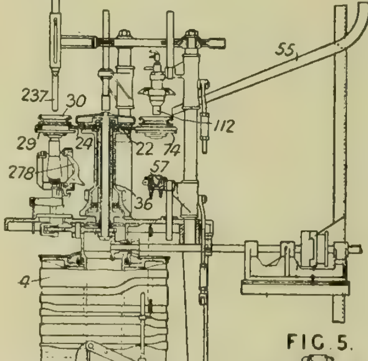


FIG.15

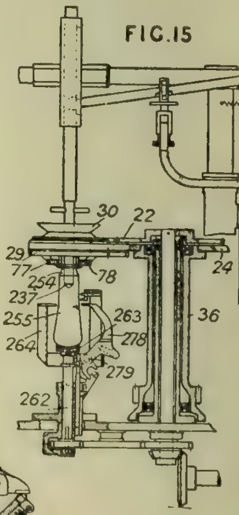
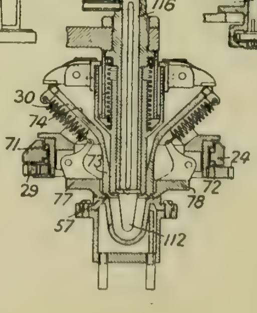


FIG.5.



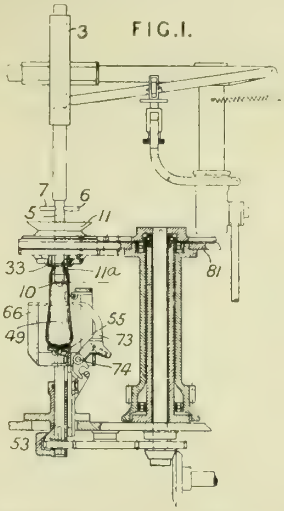
Blowing.—An automatic machine for blowing glassware, particularly electric lamp bulbs, is provided with means for burning-off the finished article from the neck of glass that is held by the ring mould, and for ejecting this neck or "lost head" from the machine at the conclusion of the cycle of forming-operations.

Operation. The machine comprises a central rotary column 36, Fig. 2, to which a table 24 is secured, and four ring moulds 30 rotatably mounted on the table. A rotatable arum 4 is formed with a number of cam tracks by which the different devices for forming a bulb are controlled. The table 24 is rotated intermittently to carry each ring mould in turn to one of four stations. At the first station, a charge of metal received from a feeder is pressed in a mould 57 to form a parison; at the second station the parison is blown in a finishing-mould. At the third station the article is separated from the "lost head," and at the fourth the "lost head" is ejected from the machine.

Construction of ring moulds. Each ring mould consists of a body portion 30 mounted in ball bearings 71, 72 in the table 24, a gear wheel 29, secured to the body, enabling the mould to be rotated at appropriate times. A funnel-shaped member 74 secured to the body 30 has its lower end 73 formed into a cylinder, and spring-controlled grippers 77, 78 co-operate with the cylinder 73 to form and hold a rim of glass on the upper edge of the parison. In forming the parison, a charge of metal from a shoot 55, Fig. 2, is guided by the funnel 74 into a water-jacketed mould 57 which has been raised into contact with the underside of the parison mould. A pressing-plunger 112 is lowered into the mould 57 through the cylinder 73 and presses the charge of metal into a parison. After the mould 57 is removed, puffs of air are admitted through grooves 116 in the stem of the plunger 112 to expand the parison. The plunger is then raised and the parison is left suspended from the grippers 77, 78.

Removing the formed article. After being blown, the finished bulb 255, Fig. 15, is separated from the "lost head" 254 or neck of glass which is gripped by the ring mould. For this purpose, a burner 237 descends through the ring mould and directs sharp flames against the inner wall of the bulb. The flames melt through the glass, while the bulb is being rotated, and the pressure of the flames prevents the upper edge of the finished bulb from flanging inwards. During the operation, the bulb is supported and centred. The supporting-device consists of a seat 263 loosely mounted on a shaft 262 which is movable vertically and is rotated in unison with the ring mould. A frame 264, pivoted on the upper end of the shaft 262 carries rollers which centre the bulb. When the glass of the bulb is sufficiently fused, the frame is lowered and the bulb detaches itself from the "lost head." At the same time, a bifurcated lever 278, operated by the movement of the frame 264, is turned about its pivot 279 and removes the bulb from the machine. The "lost head" is removed from the ring mould, after the next movement of the table 24 by a plunger which descends through the ring mould and pushes the "lost head" out of the grippers 77, 78.

241,189.—**Glass manufacture.** Naamlooze Vennootschap Internationaal Octrooibureau, 6, Emmasingel, Eindhoven, Holland. October 1, 1925. No. 24543. Convention date, October 10, 1924. Not yet accepted. Abridged as open to inspection under Section 91 of the Act. (Class 56.)

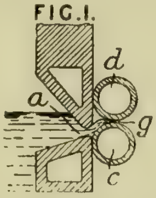


Shaping Glassware after formation.—Relates to a method of separating hollow glass articles, particularly electric lamp bulbs, from the surplus neck portions to which they are attached after removal from the blowing-mould. According to the invention, separation is effected by means of a gas flame, applied to the interior of the neck of a bulb, which melts through the glass and prevents the rim of the finished bulb from flanging inwards. The bulb 49 is shown held by a ring mould 11, a number of which are mounted on a table 81 forming part of an automatic bulb-blowing machine, means being provided for rotating the mould at appropriate times. The upper edge of the neck of the bulb is held between spring-operated grippers 33 and the lower edge of a cylindrical member 11a. A burner 5, having a ring of jets 10 and to which gas and compressed air or oxygen is supplied through tubes 6, 7, is movable vertically through a guide sleeve 3. In order to sever the bulb from the surplus neck portion or "lost head," the burner is lowered through the ring mould, which is in rotation, and flames from the jets 10 fuse through the glass along a narrow circumferential zone. The pressure of the flames also prevents the fused rim, which forms the edge of the finished bulb, from flanging inwards. During the operation, the bulb is supported and centred. The supporting-device consists of a seat 55 loosely mounted on a shaft 53, which is movable vertically and is rotated in unison with the ring mould. A frame 66, pivoted on the upper end of the shaft 53, carries rollers which centre the bulb. When the neck of of the bulb is fused, the frame is lowered and the bulb detaches itself from the "lost head." At the same time, a bifurcated lever 73, operated by the movement of the frame, is turned about its pivot 74 and removes the bulb from the machine.

241,206.—**Glass manufacture.** Soc. Anon. Des Manufactures des Glaces et Produits Chimiques de St.-Gobain, Chauny, et Cirey, 1bis, Places des Saussaies, Paris. October 8, 1925, No. 25112. Convention date, October 9, 1924. Not yet accepted. Abridged as open to inspection under Section 91 of the Act. (Class 56.)

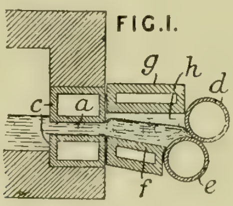
Rolling.—Relates to a process of making sheet glass in which molten glass flows through a horizontal slot *a* in the front wall of a tank or forehearth and passes between rollers *c*, *d* arranged in contact with the outer face of the wall. According to the invention, the pass between the rollers is above the horizontal plane passing through the slot *a*, so that the glass comes into immediate contact only with the lower roller, and touches the upper roller only in the zone *g* where flattening is effected. The glass is subjected to a minimum of cooling, and the upper surface of the sheet formed by the rollers is sufficiently plastic to permit of the impression of a pattern.

FIG.I.



241,207.—**Glass manufacture.** Soc. Anon. Des Manufactures des Glaces et Produits Chimiques de St.-Gobain, Chauny, et Cirey, 1bis, Place des Saussaies, Paris. October 8, 1925. No. 25113. Convention date, October 10, 1924. Not yet accepted. Abridged as open to inspection under Section 91 of the Act. (Class 56.)

FIG.I.



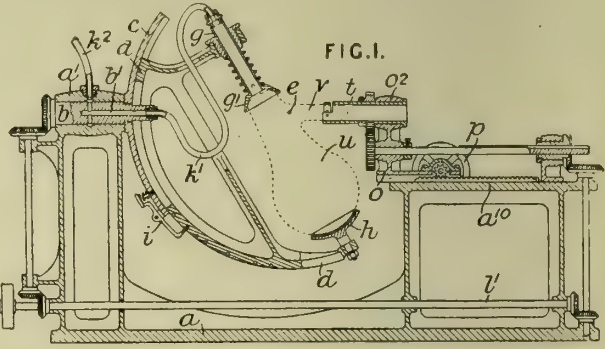
Rolling.—Relates to a method of making sheet glass in which molten glass, issuing from a horizontal slot *a* in the wall of a tank or forehearth, flows over an inclined slab *f* to a pass between rollers *d*, *e* by which the sheet is formed. According to the invention, the space above the slab is enclosed by a top slab *g* and side members *h*, and the slabs *f*, *g* and the members *h* are made hollow so that they can be heated by flames from burners directed into the internal spaces. The side members *h* may be movable so that they can be used to adjust the width of the stream of glass or to close the opening of the slot *a*. The slot is also formed in a hollow member *c* the interior of which can be heated by burners.

241,890.—**Glass manufacture.** Jenaer Glaswerk Schott & Gen., Otto-Schott-Strasse, Jena, Germany. October 15, 1925, No. 25743. Convention date, October 21, 1924. Not yet accepted. Abridged as open to inspection under Section 91 of the Act. (Class 56.)

Welding and jointing.—A device for facilitating the attachment of an extension to a glass vessel, such as the fusion of an exciting tube on to the bulb of a rectifier, comprises holders for the vessel and for the extension, means for rotating the holders in unison with one another about the same axis, and means for inclining the vessel to the axis of rotation.

Construction. The device comprises a base *a* on which is cast a bearing *a*1 for the journal *b* of an arc-shaped guide *c*. A semicircular carriage *d* slides in the guide *c* and is thus free to move about a centre *e* which lies in the axis of rotation of the guide *c*. The glass vessel *u* is supported on the carriage by means of a seat *h* and by a spring-pressed hood *g*1 on one end of a tube *g*. A flexible pipe *k*1 connects the tube *g* with an axial boring *b*1 in the journal *b*, and this communicates in turn with a supply pipe *k*2. The carriage *d* may be held in various positions relative to the guide by means of a latch *i*. The glass extension *v*, which is to be attached to the vessel *u*, is supported by a tubular holder *t* journaled in a bearing *o*2 and so arranged that its axis is in line with that of the journal *b*. The bearing *o*2 is mounted on a carriage *o* which may be traversed along a guide table *a*10 by means of a handwheel *p*, the movement of the carriage being parallel with the axis of the journals *b*, *t*. Both journals are geared with a shaft *l*1 in such a manner that rotation of the shaft rotates both the journals in unison with one another.

FIG.I.



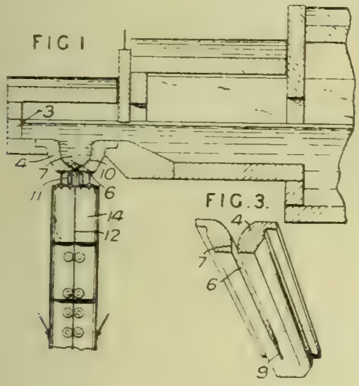
Operation. In use, a rectifier bulb, say, is mounted between the seat *h* and the hood *g*1, the carriage being so positioned that a glass tube in the holder *t* is normal to the surface of the bulb. The bulb is heated at the point of fusion by means of a burner held in the hand, and the hot glass is expanded and burst, to form an aperture in the bulb, by means of compressed air supplied through the pipes *k*2, *k*1. The carriage *o* is now moved to bring the tube *v* into contact with the bulb, and the joint is completed by rotating the bulb and tube while heating the joint with the blowpipe. When the joint is completed, the carriage *d* can be moved around the centre *e* to enable the tube *u* to be set at any predetermined angle to the bulb.

241,902.—**Gas-producers.** Breisig, A., 46, Erdbrustgasse, Vienna. October 20, 1925. No. 26182. Convention date, October 21, 1924. Addition to 207,561. Not yet accepted. Abridged as open to inspection under Section 91 of the Act. (Class 55 (i).)

In a method of working producers in which part of the gas generated is passed through a superheater and then brought into contact with the fresh fuel, as described in the parent Specification, the amount of heat so returned to the producer is sufficient to yield a surplus of coke which is removed continuously.

242,167.—**Glass manufacture.** Marks E. C. R., 57, Lincoln's Inn Fields, London.—(Libbey-Owens Sheet Glass Co.; Toledo, Ohio, U.S.A.) April 8, 1925, No. 9409. (Class 56.)

Drawing.—A method of forming sheet glass consists in flowing glass downwardly from a container through a slot having restricted end portions, and providing for a freer flow of the glass above the restricted ends than of that above the wider central portion of the slot. The slot is formed in a refractory block 4 which is arranged in the bottom of a shallow flowing-tank or forehearth 3. Glass flows through the slot and forms a sheet 12 which passes between coolers 11 into an annealing chamber 14. The central portion 6, Fig. 3, of the slot is considerably wider than the thickness of the sheet to be produced and the walls 7 of the slot extend vertically upwards for several inches and then curve outwardly. The short end portions 9 of the slot are narrower than the central portion 6, and the part of the block above the narrow ends is hollowed out to form receptacles 10, Fig. 1. The receptacles 10 provide a large body of relatively hot glass above the narrow ends 9 of the slot. The vertical walls 7 above the wider portion 6 of the slot cause the glass to flow more slowly into the central portion of the sheet.



* * *

Latest British Patents.

Applications for Patents.

No. 28812.—November 16, 1925. T. R. Wollaston. Gas Producers.

No. 28933.—November 17, 1925. H. Bland. Closure Discs for Milk Bottles, etc.

No. 29005.—November 17, 1925. (Germany, November 27, 1924). F. Wust. Reverberatory Furnaces.

No. 29203.—November 19, 1925. T. P. Miles. Swing Mirrors, etc.

No. 29344.—November 20, 1925. H. Waring. Gas-scrubbing processes.

No. 29359.—November 20, 1925. (Austria April 3). J. Schwab. Regenerator Air-heaters.

No. 29394.—November 21, 1925. W. R. Innes. Reinforced Glass.

No. 29523.—November 23, 1925. W. J. Mellersh-Jackson (Hartford Empire Company). Manufacture of Blown Glassware.

No. 29532.—November 23, 1925. J. F. Kennedy. Wine Glasses, etc.

No. 29649.—November 24, 1925. (Germany, June 22). Oertling and Rehders. Glass-cutting Diamonds.

No. 29663.—November 24, 1925. (Germany, August 1). General Electric Co., Ltd. Manufacture of Glass.

No. 29664.—November 24, 1925. (Germany, August 1.) General Electric Co., Ltd. Manufacture of Glass.

No. 29762.—November 25, 1925. A. S. Alexander. Bottle Cork.

No. 29882.—November 26, 1925. (Germany, November 28, 1924). Soc. Anon. des Manufactures des Glaces et Produits Chimique de St. Gobain, Chauny, et Cirey. Apparatus for equalisation of density of fluid mixtures.

No. 29900.—November 26, 1925. W. G. Freudenthal and L. Kremner. Vacuum Tubes, etc.

No. 29941.—November 26, 1925. (Germany, November 27, 1924). B. Versen. Reverberatory Furnaces.

No. 30112.—November 28, 1925. (Germany, March 18, 1925). General Electric Co., Ltd. Gas filled Electric Lamps.

No. 30113.—November 28, 1925. (Germany, August 20, 1925). General Electric Co., Ltd. Manufacture of Bulbs for Incandescent Electric Lamps, etc.

No. 30133.—November 28, 1925. Holophane Ltd. Illuminating Appliances.

No. 30315.—December 1, 1925. C. H. Rankin. Apparatus for controlling flow of Molten Glass through Discharge Aperture.

No. 30339.—December 1, 1925. C. R. Nixon, J. L. Dunnock, W. B. Swindell. Bottle Polishing Machine.

No. 30376.—December 1, 1925 (Italy, June 3, 1925). A. Baudino. Polishing Discs.

No. 30391.—December 2, 1925 (Belgium, December 2, 1924). V. Selliez. Processes of burning and cooling Ceramic Products in Kilns.

No. 30455.—December 2, 1925. F. G. Ginzler. Closures for Jars, etc.

No. 30479.—December 2, 1925. (Germany, December 2, 1924). Steingasser and Co. Grinding or Polishing Machines.

No. 30496.—December 2, 1925. (American Flat-Lite Co.). Reflectors.

No. 30511.—December 2, 1925. F. Parentani. Purification of Clay, etc.

No. 30550.—December 3, 1925. W. A. Stephens. Closures for Receptacles.

No. 30620.—December 4, 1925. M. Cullum. Bottle Pourer.

No. 30675.—December 4, 1925 (April 6). J. R. C. August, E. K. Hunter. Optical Projection Systems.

No. 30743.—December 5, 1925. H. V. Nielsen. Bottle-filling Machines.

No. 30796.—December 5, 1925. C. Cooper. Drying Fuel Gases.

No. 30851.—December 7, 1925. (France, December 22, 1924). M. Fourment. Treatment of Gases at High Temperatures.

No. 30916.—December 7, 1925. H. Spengler. Bottle Closure.

No. 30931.—December 8, 1925. G. E. Wade. Ink Bottles.

No. 31003.—December 8, 1925. Matthews and Yates, Ltd. and G. Thompson. Means for Preventing Obscuring of Windows.

No. 31014.—December 8, 1925. (Switzerland, December 17, 1924). Vacuum Flasks.

No. 31015.—December 8, 1925. W. Okines. Supporting Device for Glazing, etc.

No. 31028.—December 9, 1925. B. H. T. Rodd. Process for Repairing Panes of Glass, etc.

No. 31127.—December 9, 1925. W. Koreska. Bottle Closures.

No. 31147.—December 10, 1925. Dawson Bros., Ltd., D. H. Dawson, G. Dawson. Bottle Washing, Filling, etc. Machines.

No. 31191.—December 10, 1925. (United States, December 18, 1924). British Thomson-Houston Co., Ltd. X-ray Devices.

No. 31303.—December 11, 1925. G. E. Wade. Ink Bottles.

No. 31315.—December 11, 1925. J. F. Sargent, J. C. Wootton. Bottle Cleaning Apparatus.

No. 31467.—December 14, 1925. A. E. Wardle. Closures for Bottles, etc.

Specifications Published.

226212.—December 14, 1923. A Gobbe. Apparatus for Grinding, Smoothing and Polishing.

228196.—January 26, 1924. Libbey Glass Co. Glass Blowing Spindle Apparatus.

229250.—February 13, 1924. Jos-pe Farbenphoto Ges. Apparatus for simultaneous production of Partial Pictures in Multiplex Colour Photography by splitting up the pencil of rays passing through the Lens by Optical means.

232549.—April 17, 1924. T. R. Haglund. Process for the Treatment of Raw Materials Containing High Refractory Oxide.

235164.—June 4, 1924. Selas Akt-Ges. Safety Device for Gas and Air Mixing Plants and other Industrial Gas Plants.

237264.—July 18, 1924. British Thomson-Houston Co., Ltd. Machine for and Method of Preparing Quartz Rods or Canes.

237579.—July 23, 1924. Nammlooze Vennootschap Philips' Gloeilampenfabrieken. Glass Bulbs for Electric Incandescent Lamps or the like, and a Process for Repairing them.

240426.—September 23, 1924. C. Zeiss (Firm of). Optical Methods of, and Devices for, Testing the position of two Axial Directions.

242213.—November 1, 1924. Glaswerke Ruhr Akt.-Ges. Apparatus for the Manufacture of Glass Tubes provided with Closed Ends or Bottoms.

242559.—June 26, 1925. P. Jeffrey and R. Jeffrey. Closure Devices for Bottles, Jars, and other Receptacles.

242568.—August 4, 1925. Jenaer Glaswerk Schott and Gen. O. Schott, and H. Thiene. Glasses.

242574.—July 28, 1925. Soc. Anon. Ateliers J. Hanrez. Apparatus for the Manufacture of Thin Sheet Glass.

242576.—September 8, 1925. E. D. Tillyer. Opthalmic Lenses.

242703.—August 11, 1924. H. J. Clark and A. Kirby. Glass Polishing and Grinding Machines.

242859.—March 21, 1925. A. E. White (Pittsburgh Plate Glass Co.). Apparatus for Surfacing Sheets.

242880.—April 28, 1925. J. Gunning. Apparatus for Automatically Operating Gas-valves.

242907.—June 11, 1925. A. J. Jousson. Machines for Making and Applying Caps to Bottles or the like.

243033.—May 20, 1924. W. Lambert, A. A. Mead, and J. Stone and Co., Ltd. Coating of Metal Surfaces with Vitreous Coatings of Enamel, Glaze, Glass, or the like.

243092.—August 28, 1924. T. R. Wollaston. Combined Gas-producer and Furnace for use with Steam Generators. (Cognate application, 5306/25).

243117.—September 18, 1924. T. Thomson and N. Nisbet. Apparatus for filtering Dust-laden Gases.

243124.—September 27, 1924. H. Rhodes. Glass Panels for use in and upon Wireless Cabinets.

243183.—December 16, 1924. R. Jacobsson. Method of producing Pure Alumina. (Addition to 221,209).

243202.—February 9, 1925. E. Draullette. Tight-closing devices for Bottles, Preserve Tins, and similar Vessels.

243222.—April 14, 1925. H. Salan and Bader and Salan. Production of Air-Gas Mixtures for Combustion.

243230.—April 23, 1925. T. Terrell. Manufacture of Double-Walled Glass Articles.

243233.—April 28, 1925. O. L. Eugster. Syphon heads for Mineral Water Bottles, Vases, and the like. (Addition to 173,107).

Prevailing Prices.

Arsenic (Continental or Japanese) ..	†£15—£16	0	0	ton
Arsenic (Refined white powdered)	£15	0	0	ton
Cobalt (Black Oxide)	*£0	8	0	lb.
Cobalt (Grey Oxide)	*£0	8	10	lb.
Cryolite (Synthetic) 90/100%	†£37	0	0	ton
Manganese Peroxide 85/87%	*£19	0	0	ton
Potash (Hydrated Carbonate) 83/85% ..	†£22	10	0	ton
Potassium Nitrate	*£24	0	0	ton
Red Lead, Finest English Manufacturing Glass Makers' quality	*£2	6	0	cwt.
Selenium (Black powdered) 99/100% ..	*£0	7	6	lb.
Soda Ash (Heavy)	£6	5	0	ton
Soda Ash (Light)	£5	17	6	ton
Sodium Nitrate (Refined Chilean) 96% ..	£12	15	0	ton
Sodium Nitrate (Synthetic) 96%	†£13	10	0	ton
Sodium Selenite	*£0	5	6	lb.
Sodium Silico Fluoride	*£17	0	0	ton

The above prices are for usual commercial quantities.

* d/d. Works.

† c.i.f. U.K. port.

243310.—November 20, 1924. Naamlooze Vennootschap Philips' Gloeilampenfabrieken. Incandescent Cathode X-ray Tubes. (Addition to 208,108).

243459.—September 3, 1924. C. H. Rankin. Apparatus for Feeding Molten Glass to a Discharge Aperture.

243522.—November 25, 1924. T. Westwood. Stoppers or Closures for Bottles or Containers.

243638.—June 30, 1925. E. C. R. Marks (Danner E.). Process and Apparatus for the Manufacture of Figured Sheet Glass.

243813.—September 5, 1924. R. W. Penn and W. A. Stephens. Closures for Bottles and other Receptacles. (Cognate application, 22358/24).

243871.—October 23, 1924. S. M. Gluckstein and W. G. Knibbs. Bottle Closures.

243880.—November 1, 1924. United Glass Bottle Manufacturers, Ltd., T. C. Moorshead and A. Riley. Machines for Making Glassware and the like.

244357.—July 15, 1925. O. Adamson. Method of and Apparatus for Preventing Condensation on Surfaces such as Glass or the like.

Specifications Open to Public Inspection.

242597.—November 6, 1924. Soc. Anon. A' Exploitation des Brevets Cousin Dite le Chauffage Industriel. Air Blast device for Semi-water Gas-producers.

242628.—November 4, 1924. Naamlooze Vennootschap Philips' Gloeilampenfabrieken. Sealing-in machines.

242937.—November 13, 1924. General Electric Co., Ltd. Manufacture of Translucent or Coloured bulbs, more especially for Electric Incandescent Lamps.

242946.—November 17, 1924. Naamlooze Vennootschap Philips' Gloeilampenfabrieken. Electric Discharge Tubes.

Patents, Trade Marks, Inventions.—Advice, Handbook and Consultations free. King's Patent Agency Ltd., Director B. T. King, C.I.M.E., Regd. Patent Agent, G.B., U.S., and Canada, 146a, Queen Victoria Street, E.C.4, and 6, Quality Court (next Patent Office), London, W.C. 39 years' references. 'Phone: Cent. 682.

GLASSWORKS CHEMIST.

Experienced in crystal and ordinary flint, coloured and tinted glasses, Crookes glasses and stained glass window manufacture. Used to both pot and tank furnace practice, hand-made ware—including tableware, clinical thermometer tubing and scientific glassware, and also to fully automatic bottle production. Good knowledge of factory organisation and engineering.

Ex-pilot R.A.F., age 30, married. Seeks progressive appointment at home or abroad. Full particulars and references on application:—

A. E. Gardiner, 21, Chestnut Road, London, S.E.27.

Vitreous Enamel Colours.

Stains for Glass.

Oxides for Colouring Glass Metal.

Selenium Metal.

Selenate and Selenite of Soda.

GROUND BONE, FELSPAR, FLINT, FLUORSPAR, QUARTZ, STONE, WHITING, ETC.,

CARBONATE & SULPHATE of BARYTES

OXIDES OF ANTIMONY, ARSENIC, CHROME, COBALT, SMALTS, COPPER, IRON, MANGANESE, NICKEL, TIN, TITANIUM, URANIUM, ZINC, ETC

TRADE CERAMIC MARK

WENGERS, LTD.

CERAMIC COLOURS & CHEMICALS

ETRURIA.

STOKE-ON-TRENT.

England.

Samples & Price Lists Sent on Demand.

COLOURS for POTTERS, GLAZED BRICK MANUFACTURERS, & GLASSMAKERS.

PREPARED ENAMELS for CAST & SHEET IRON, COPPER & JEWELLERY.

Limespar.

Phosphate of Lime.

Nitrate of Soda.

Nitrate of Potash.

Opavetro for Opacifying Glass.

Alumina, Oxide and Hydrate.

GLASS

THE RECOGNIZED ORGAN OF THE GLASS INDUSTRY
Published on the Tenth of Each Month.

Single Copies - - - - One Shilling
Annual Subscription - - 10/6 post free

GLASS PUBLICATIONS Ltd.
TECHNICAL PUBLISHERS,
Talbot House,
Arundel Street,
Telephone: CENTRAL 5985. **Strand, London, W.C.2.**

CONTENTS.

PAGE
Editorial Notes ... 87
A Remarkable Advance in Annealing ... 88
Coloured Glass and Glass Decoration.—By James H. Gardiner ... 94
The Society of Glass Technology ... 101
Trade Notes ... 109
The Corrosion of Glass Surfaces.—By George W. Morey ... 111
The Optical Society ... 116
British Glass Trade, 1925. ... 117
Electrically Heated Lehrs ... 118
December Trade Returns ... 119
United States Patents ... 120
British Patents ... 123
Latest British Patents ... 127

Editorial Notes.

The last week in January witnessed the annual meetings of the principal Banks and as is customary on such occasions the respective Chairmen attempted to forecast the prospects for British trade during 1926. In view of the authentic information and statistics available for the preparation of these attempts it is pleasing to note that in each instance the future was referred to with a certain amount of tempered optimism. Of course British trade as a whole was considered, but we have also had statements from the leaders of several important industries, confirming the opinions expressed by the banking interests. All such forecasts, however, are contingent upon the settlement of the coal question before the end of April as a national stoppage of the pits in May would be a blow which would entirely destroy and nullify the efforts of employees and employers in all other industries during the last few years which at the present time would appear to be within measurable distance of being rewarded.

In connection with the coal question, it is somewhat significant that both sides appear to realise the futility of negotiating on a national basis, questions upon which there is no national uniformity but which vary from one district to another, and one is compelled to wonder whether this does not mean a general revulsion with respect to the craze for amalgamations and unification of control. National organisations will always be advisable for negotiating national problems, but it is becoming more and more apparent that the internal problems of any industry are best left in the hands of those thoroughly acquainted with the conditions peculiar to each individual case.

It is exceedingly difficult to formulate any definite opinion as to the 1926 prospects for the glass industry as the majority of glass manufacturers are in the unfortunate position of being dependent upon other industries for their orders, in that, apart from the domestic and fancy ware, the manufacturer seldom, if ever, sells direct to the final buyer. In other words, glass is an accessory to other trades and the prosperity or otherwise of the glass manufacturer is irretrievably bound up with the conditions prevailing in industries over which he has no control.

If it is possible to take the demand for new equipment as a criterion, it is safe to say that bottle and container manufacturers are looking forward to the prevalence of better conditions. During the last month of 1925 and so far this year, quite a number of new machines have been ordered by factories in different parts of the country whilst enquiries are reported to be more frequent than was the case last year.

At a meeting held in Birmingham it was decided to make yet another attempt to obtain Tariff Protection for the Flint Glass industry and as will be seen from the figures given on pages 117, 118, in this issue, this section of the trade is in a very serious position. During the meetings which have been held in connection with previous applications there have been references to the amount of capital that has been sunk in attempting to modernise equipment, etc.

At the commencement of the war the bottle manufacturers found that their factories were very much behind those in America as regards machines and methods, and the majority of them immediately reorganised their installations and adopted the then latest productive devices, etc., also since then they have consistently kept up to date. This, of course, involves the employment of automatic machines, feeding devices, etc., and in view of the almost universal use of these same machines in America for the production of domestic and fancy ware, it would be interesting to know how many, if any, feeder-fed, automatic presses there are installed in this country for making the same class of ware. The Continental manufacturers are installing this type of equipment at the present time, so that it is possible that even with the tariff against them, they will be able to compete successfully in price with the British goods unless the British factories help themselves, as well as ask others to help them.

[GLASS *will deal with all matters pertaining to the industry in an impartial manner, consequently the Editor does not necessarily associate himself with the opinions expressed by his contributors.*]

A Remarkable Advance in Annealing.

An entirely new principle in Lehr Design.

The necessity for proper annealing is not confined exclusively to the manufacture of glassware, as the operation is required in connection with many other industries, such as in metal working, where, during drawing, rolling and hammering, the article or material operated upon, is annealed frequently during the process. Whilst, however, there may be a similarity between the methods employed in such cases and those used in annealing glassware, the reasons for the treatment are not exactly the same.

Until a comparatively few years ago, the most important desideratum in annealing glassware was considered to be " slow " cooling, based on the theory that, " the longer the cooling period the better the annealing," and it is still possible to find some of the old " bottle arches " in use, where the bottles are allowed to cool over a period of about three days. With the advent of improved methods of manufacture the " arches " were found to require too much space owing to this time factor and they generally gave place to the tunnel or " continuous " type lehr, in which one end is maintained hot by means of burning coal, coke, gas or oil (latterly electricity has been successfully employed), and the other cold; various ways and means being adopted to convey the bottles or glassware progressively from the hot to the cold end.

In addition to reducing considerably the time occupied in the process (down to 7-8 hours) it was found that the adoption of these tunnel lehrs also resulted in a material saving in the fuel consumed, owing to the fact that a mass of brickwork, etc. was not being alternately heated and cooled as was the case with the " bottle arches."

It was only to be expected that these early lehrs should be rapidly improved although these improvements were chiefly, if not solely, connected with the mechanical construction of the equipment (especially with the chain and slats, etc. forming the continuous conveyor for carrying the glassware) making the lehrs more efficient from the point of view of fuel consumption and quality of annealing, as well as less liable to breakdown, but otherwise the principles employed remained the same.

With all the systems, however, there was always a certain loss of ware due to defective annealing, and prior to the war this would appear to have been considered a manufacturing risk and unavoidable. In addition, owing to the fact that the products of combustion passed down the same chamber as the ware, the latter invariably arrived at the cold end covered with a " bloom " which had to be removed by washing before the bottles could be used.

In an endeavour to obtain a better distribution of heat throughout the hot section of the tunnel different makers adopted the " muffle " principle in which the heat was applied to the outside and all round—i.e., top, bottom and sides—the hot end of the tunnel, and this went a long way towards achieving the desired results, as not only was a better and more regular distribution of heat obtained, thus reducing the loss or breakage in the lehr and giving better annealing, but the "bloom" was avoided as the gases were prevented from coming in contact with the ware. Also the time required to pass the bottles through the lehr was reduced to an average of about 4-5 hours.

During the period of the introduction of these improvements, numerous workers were engaged in researches into the chemical and physical questions connected with annealing, and it was soon evident from the results obtained that existing theories upon the subject would have to be modified considerably. Further research showed that for each and every glass there exists what are termed, upper and lower annealing temperatures, also that instead of a uniform rate of cooling being advisable, the rate should vary at different stages during the cooling process, and it was shown that the time required to anneal bottles could be again materially reduced, under ideal conditions the time required being less than twenty minutes for certain ware.

As the ware leaves the finishing moulds of a forming machine there are usually differences in temperature between various parts of any individual article, the outside naturally being the coolest portion. Nevertheless, in spite of this fact, with modern rates of production, the total heat contained by the ware as it leaves the mould, if distributed equally throughout it, will usually be sufficient to raise every part to a temperature sufficiently high to release any existing stress, so that if the disposition of the lehr is such that advantage may be taken of this fact it will be obvious that a considerable economy in fuel will result.

Numerous and costly experiments were carried out in an endeavour to arrive at a lehr design which would enable glass manufacturers to obtain the maximum practical value from this research work and we have pleasure in describing the latest developments in this direction which are embodied in the " Hartford " lehr.

One of the outstanding features to be noticed from the illustrations is the absence of brickwork, both ordinary and refractory, the whole of the construction, with the exception of the fire box lining, being metallic. The annealing chamber proper through which the bottles pass, consists of a series of short cast iron sections securely fastened together in such a manner that the chamber is hermetically tight—top, bottom and sides—throughout the entire length. The bottom of the chamber is hollow throughout the whole length of the closed part of the lehr whilst the top is hollow

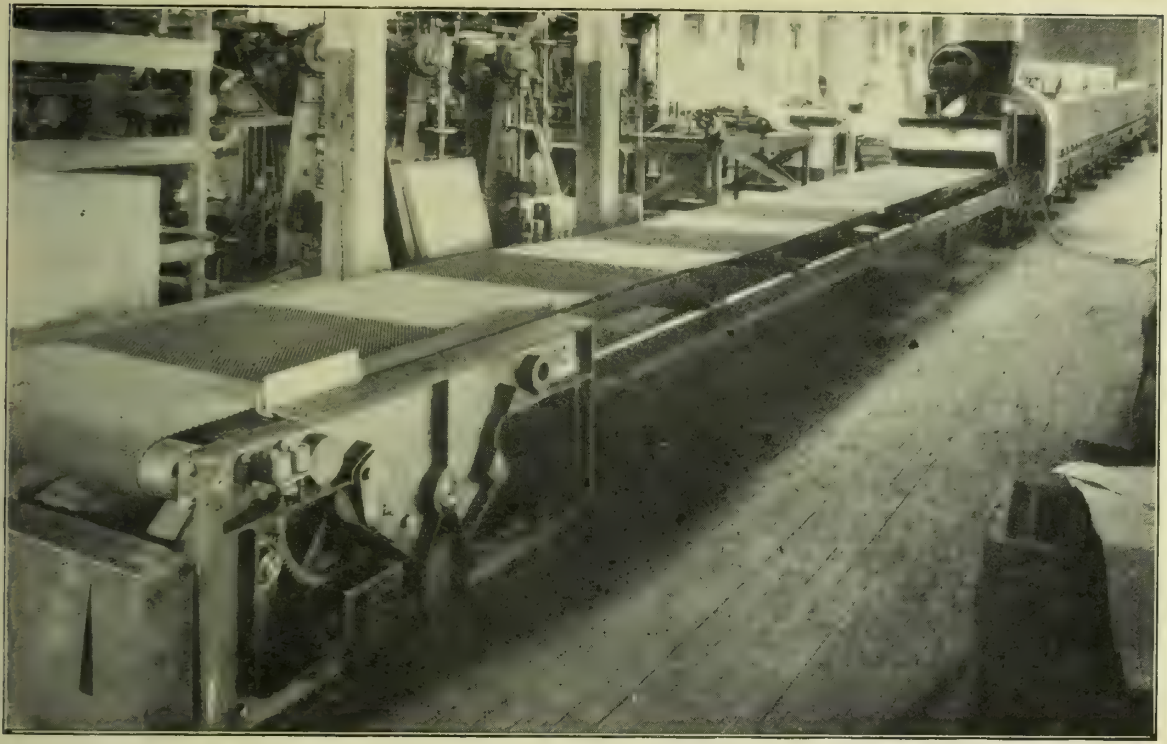


Fig. 1.

View of cold end of Annealer, showing driving gear. The "open" portion was made specially long in this instance to carry the ware to the packing room.

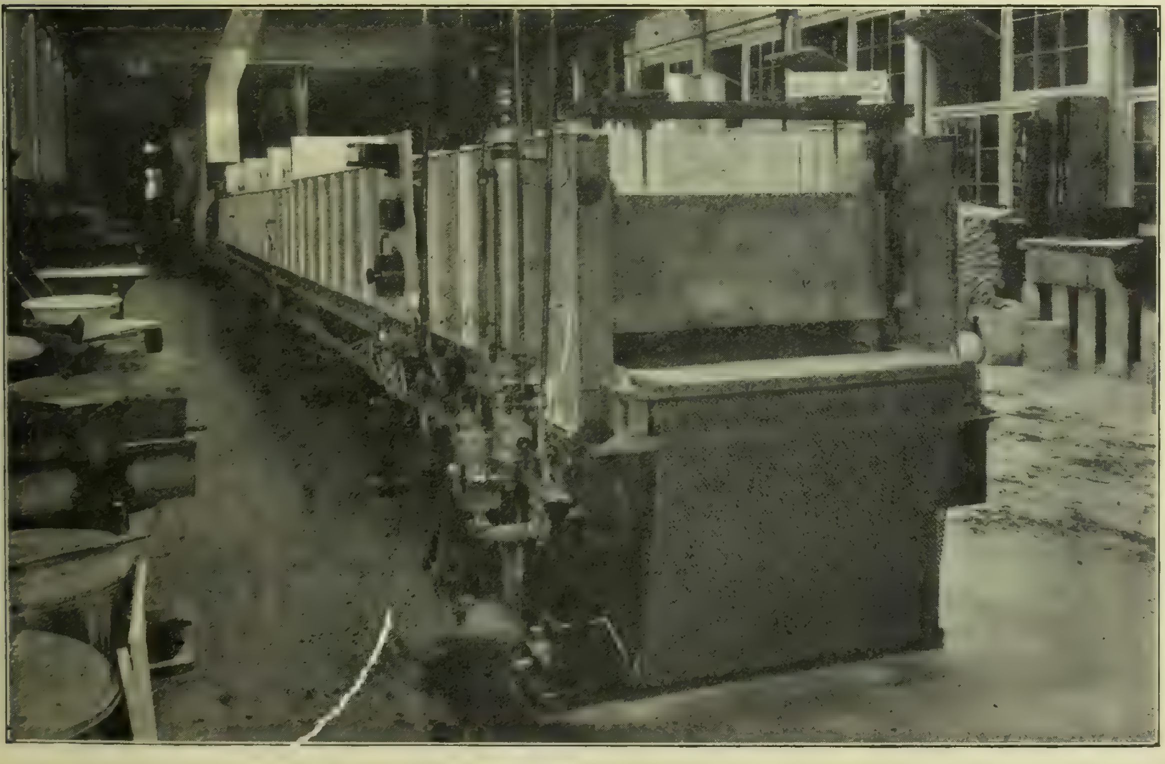


Fig. 2.

View of hot end of Annealer,

for a considerable portion of the distance from the cold end towards the hot.

The hollow top and bottom each form a long continuous tunnel, so that the lehr may be considered as consisting of three continuous and entirely distinct chambers arranged one over the other, the glass ware passing through the middle one. Both top and bottom flues or ducts are connected to the inlet of an induced draft fan, dampers being provided in order that the draft or " pull " in each case may be under complete and independent control.

Owing to previous experiments in this direction in which an attempt was made to avoid completely the use of additional heat, one often hears these lehrs referred to as " fireless,'' but it should be made clear at once that the consumption of a certain amount of fuel is a necessity to the principles of operation of the one we are describing, although the amount of fuel so required is reduced to a comparatively small percentage of that usually consumed in existing types.

This fuel is burnt in a small combustion chamber placed underneath the front or hot end of the lehr and the only outlet for the hot gases is by passing into and through the lower tunnel forming the bottom of the annealing chamber ; the necessary draft or "pull" being provided by means of the induced draft fan as shown in Fig. 4.

At various points throughout its length cold air may be admitted to this hot gas tunnel or flue, the amount so admitted being capable of accurate control by means of a very simple yet highly effective species of valve at each point. It will thus be obvious that, as the amount of air entering at each point can be regulated from nothing to the maximum, independently of the others, the dilution of the hot gases with cold air and consequently the temperature of the tunnel may be made to conform to any desired or predetermined cooling curve, especially as the draft intensity or pull can also be controlled—independently of that due to temperature of the gases—by means of dampers placed in the connecting trunks between the lower tunnel and the exhaust fan inlet.

Due to conduction, convection and radiation the top portion of the annealing chamber becomes heated, and the means adopted to control the temperature in this portion involve a reversal of the method used with the bottom section. A secondary or auxiliary suction pipe is run along the top of the lehr from the inlet of the fan, the far end of the pipe being closed. Downcomers provided with regulating dampers connect this auxiliary suction pipe with the top tunnel or duct at various points. This tunnel is open to the atmosphere at the cold end of the lehr only, so that if one of the dampers in the downcomers just mentioned be opened, cold air is drawn into and along the tunnel until it reaches the downcomer in question, it then passes upwards into the auxiliary suction pipe and back to the fan.

A little consideration will show, therefore, that in this way exactly the same facilities for control are obtained for the top as for the bottom, it simply being a question of adjusting the dampers to cause the cold air to travel a greater or lesser distance before it passes into the auxiliary main and to regulate the positions (and quantities) at which it is withdrawn en route, and in this manner it is possible to regulate the temperature at the top of the lehr without affecting that existing at the bottom.

It should be realised, however, that the positions, spacing and sizes of the various connections in the upper and lower flues have been calculated to give the desired results and are not simply haphazard dimensions.

One of the advantages of this method of temperature control is that, as the pressure in both top and bottom flues or ducts is less than atmospheric or that existing in the middle tunnel through which the ware passes, it is impossible for there to be a leakage of cold air or hot gases into the centre tunnel, causing local cool or hot spots which seriously interfere with the successful annealing of the ware.

In the construction of the lehr full advantage is taken of the benefits to be obtained from the correct use of heat insulation and here again the quantities used at the different positions are the results of study and experiment.

In the illustrations a number of small rollers will be noticed down the side of the lehr. These are attached to the lehr proper and are the only connection between it and the supporting structure, except at the hot end. In this way expansion of the various parts is allowed for, as the whole of the lehr is free to move longitudinally with reference to the supports without in any way straining joints or otherwise affecting the successful operation of the whole. This feature of the construction is one which many works managers will appreciate as obviating the difficulties due to warping of angles, runners, etc. with the consequent trouble with chains, etc.

The belt or conveyor portion of the lehr is extremely interesting as it represents a complete departure from existing practice. Instead of the usual pressed steel slats—to form the carrying surface—attached to two or more chains to take the strain and carry the weight, the belt in question is composed of interlaced spirals made of steel wire. It is found that this arrangement works extremely well and possesses numerous desirable features. It is very flexible, does not warp due to heat, whilst no additional chains are required. Furthermore, it possesses a very low "heat mass" and consequently not only does it quickly attain the temperature of the hot end of the lehr on entering but does so without requiring the expenditure of considerable fuel. In addition, owing to its open construction it does not act as a mask to the bottom of the lehr but allows the heat radiated from it to have direct access to the bottoms of the ware, and as the ware is supported by the summits of a few spirals, practically point contact is obtained. The advantage of this may be judged from the fact that no case has yet been found of a bottle with strain in the bottom, the usual position with some of the older systems.

The load on the belt is not sufficient to cause serious rubbing on the bottom of the annealing chamber. This bottom is machined all over so that friction is reduced to a minimum. This will be realised when it

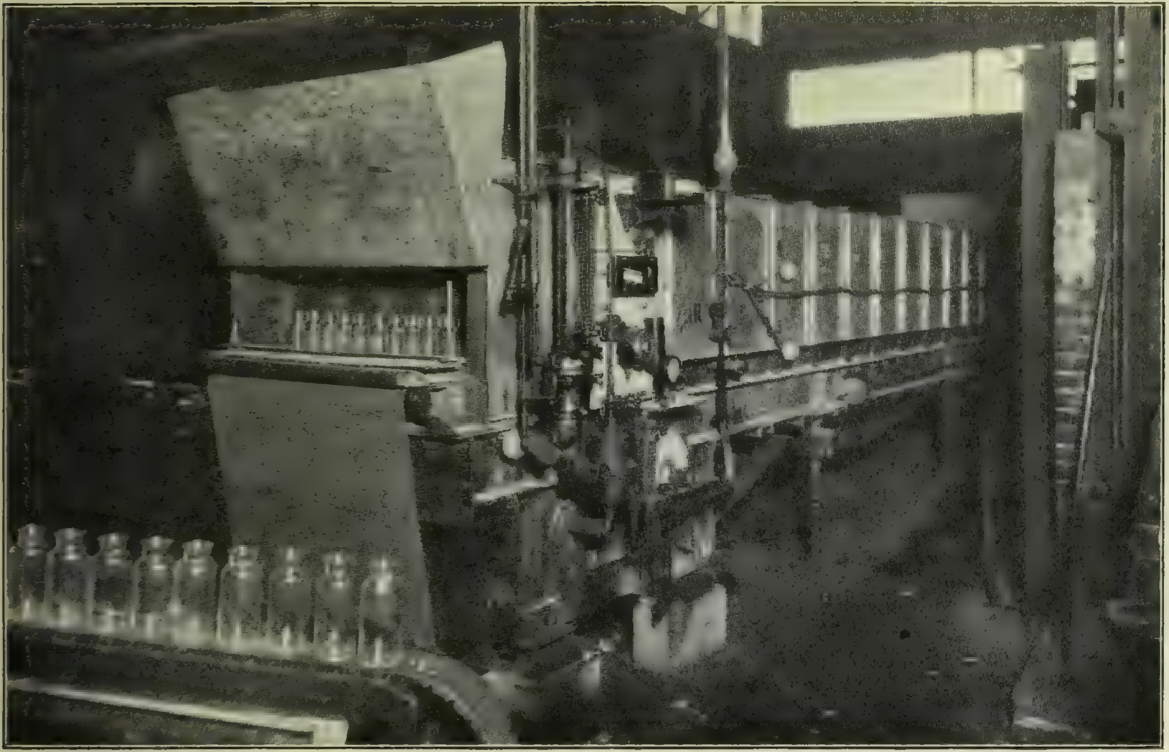


Fig. 3.

Annealer in operation. Note absence of foundations and brickwork.

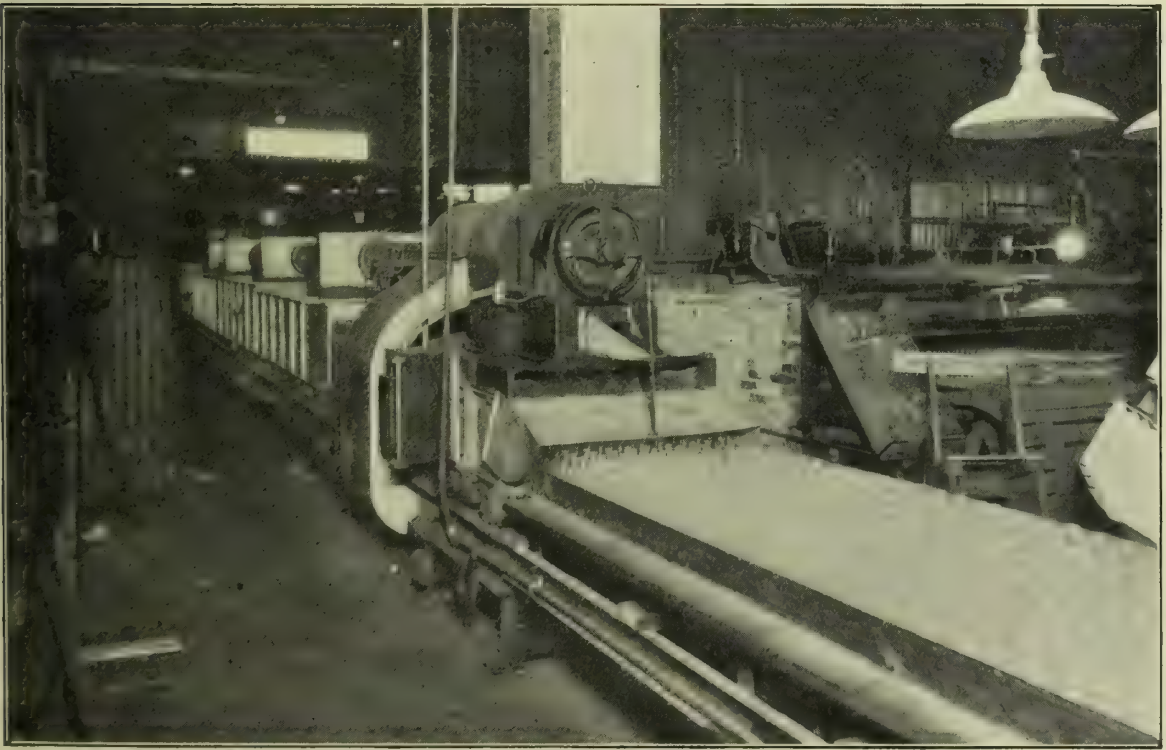


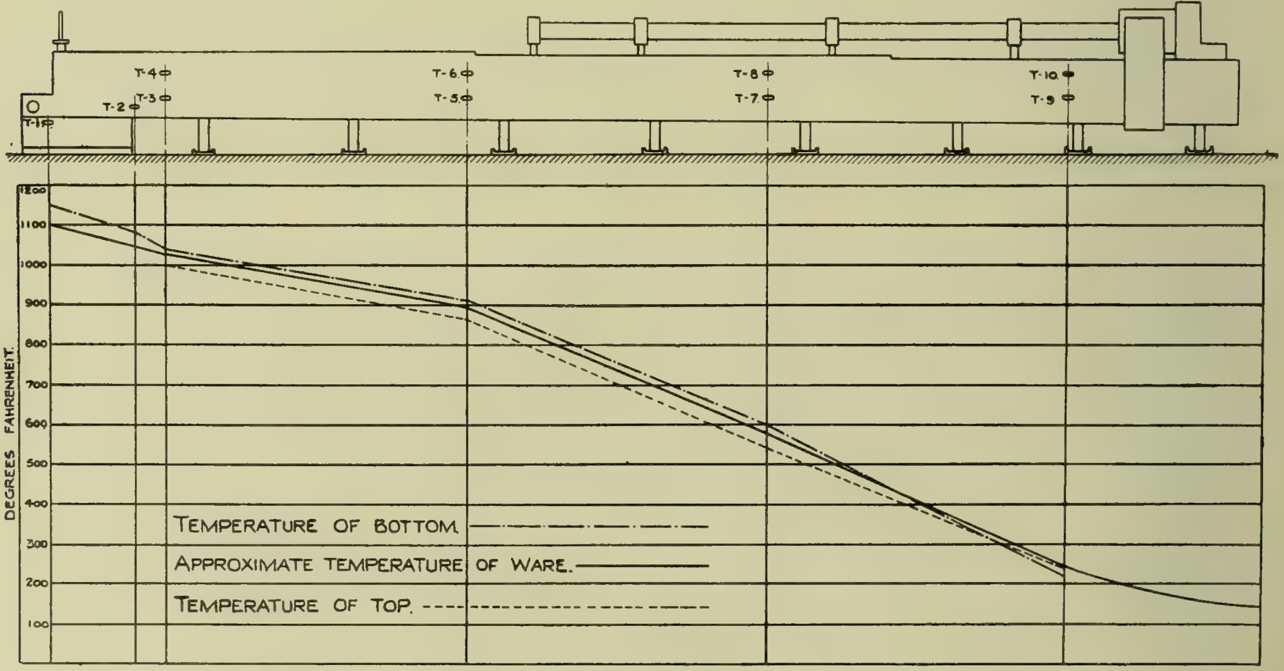
Fig. 4.

View showing Exhaust Fan. Note alignment of ware.

is stated that the driving motor installed is only 0.5 H.P. and even this gives a margin of 50%.

As will be seen from the illustrations the driving mechanism is self-contained, being placed inside the framing. The necessary tractive effort is applied to the belt by passing the latter between and around two rollers covered with a rubber compound, whilst facilities are provided for taking up any extension of the belt due to expansion or wear.

Another interesting feature in connection with the lehr is that the tunnel is erected in such a manner that there is a slight fall from the hot to the cold end. The object of this is not to reduce the power required to move the ware through the lehr, as some people appear to think, but to cause a tendency for air to flow through the centre tunnel from the cold end and therefore in the opposite direction to the movement of the ware. This flow of air, if such it may be termed, is barely sufficient to prevent the entry of cold air at the hot end of the tunnel and does not exercise any material cooling effect upon the glass.



It will be realised that it is essential to have correct knowledge of the temperature conditions at the various points in the lehr and consequently 10 thermo-couples are provided, with the necessary switch enabling any couple to be connected to the indicator. Eight of the couples are inserted in grooves in the bottom and top of the annealing chamber, those in the bottom being immediately underneath and almost in contact with the belt so that the temperatures indicated are really those existing *in* the annealing chamber at the different points. As the draft is independent of atmospheric conditions, draft gauges are provided to enable the dampers to be set correctly and also to enable any desired set of conditions to be reproduced at any future time, if so desired.

As manufactured at present—to take the maximum output of one forming machine of the Lynch, O'Neill or similar type—the annealing chamber has a section of 34 ins. wide and 15 ins. high, the closed portion of the lehr being approximately 60 feet long, but the open portion can be made any length to suit individual cases, in fact it can be made to serve as a conveyor to deliver the bottles into the packing room owing to the lightness of the belt and consequent light structure required to support it. The overall width of the lehr outside *everything*, except the two side suction ducts, is 4 ft., whilst the overall height to the top of the fan is less than 7 ft. It will thus be seen that very little floor space is required and owing to its being self-contained no foundations are required as it can be placed direct on the floor.

The cost of maintenance and repairs is practically negligible, and this obviously constitutes a marked step forward.

It may now be of interest to give some of the results obtained. Fig. 5 shows a typical annealing curve. As regards fuel consumption, actual tests in which one of these lehrs was installed and operated alongside one of the best known makes of muffle lehrs, 10 ft. wide, each lehr taking the same size and type of bottle from machines at the same tank, the respective consumptions were :—

Hartford 3,000 cu. ft. gas per 24 hours.
10 ft. muffle 35,000 cu. ft. gas per 24 hours.

The muffle lehr annealed twice the weight going through the Hartford as it was fed by two machines, so that for equal weights annealed the ratio was as 1 is to 5.8, or approximately $\frac{1}{6}$.

Against this must be set off the cost of running the induced draft fan which absorbs about 4 k.w. or 4 units per hour, but there is a saving on the power required to operate the belt, this saving reducing the extra power required to about 3 units per hour.

The actual time required to pass the bottles through the lehr has been reduced very considerably and we may mention the following.—

Type of Ware.	Weight in ozs.	Size or Capacity.	Pieces per Minute.	Time going through 60 feet lehr Tunnel.
Lantern Globe	$10\frac{1}{2}$	—	19.	43 minutes
Tablet Jar	$28\frac{1}{2}$	5″ square	10.	76 ,,
Wine Tray	36	11″ dia.	2.6	76 ,,
Mustard	$8\frac{1}{2}$	8 oz.	18.	95 ,,
Milk Bottle	26	Quart	14.5	95 ,,
Beer	28	Quart	13.	120 ,,
Flask	$8\frac{1}{4}$	—	15.5	150 ,,
Minerals	14.	6 oz.	14.5	150 ,,

Note.—In some of the above cases, notably the last two, the lehr could have been run much faster had the machine output demanded it.

From the point of view of efficiency of annealing the report of one of the largest firms of bottle manufacturers in America, after installing one and then ordering a further 15 lehrs of this type is, that they immediately got an increase of 5 per cent. in the output of saleable bottles, due solely to the improved annealing.

We should like to thank the Hartford Empire Co., Hartford, Connecticut, U.S.A., who have developed this lehr, for their permission to publish the foregoing account and photographs and would mention that the British rights have been acquired by the British Hartford Fairmont Syndicate, Ltd., Audrey House, Ely Place, London, E.C.1, the Continental interests being in the hands of Mr. J. H. O. Bunge, Watergate House, Adelphi, London, W.C.2.

We understand that one of these lehrs is now being erected at the Greenford Works of the Rockware Glass Syndicate, Ltd., and that the trade will shortly have an opportunity of inspecting it in actual commercial operation.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry.—Vol. VI. C (Part 2), Si, Silicates, by J. W. Mellor, D.Sc., pp. X + 1024; 221 Diagrams. London, Longmans Green & Co., Ltd., 1925. Price 63s. nett.

The sixth volume of Dr. Mellor's Comprehensive Treatise will receive a great welcome from all scientists, and it is of special interest and value to Glass Technologists because it contains the fullest and most up-to-date information regarding the chemistry of the silicates.

The "glass" chemist will find this work invaluable as a book of reference and will be saved hours of delving into literature, for no fact however insignificant appears to have escaped the notice of the author. Dr. Mellor indeed has collected in a remarkable manner everything that is of importance upon a difficult subject. Notwithstanding its immense value for reference, the book is no mere compilation of results for throughout it, detailed records of observation are almost invariably accompanied by masterly comments upon the various points arising.

The sections of greatest importance to the "Glass" chemist are those dealing with (1) Silica (pp. 137-145 and pp. 236-307); (2) Sillimanite (pp. 453-467); (3) Clays (pp. 467-511); (4) Glass (pp. 520-553); (5) Felspars (pp. 661-691). In view of the prominence lately achieved by sillimanite as a refractory for use in the glass industry, the data given regarding this material will be found very instructive, whilst the section dealing with clays has only to be read to be appreciated. As might be expected, this section upon clays bears the stamp of the master to a greater extent perhaps than any other portion of the book, and one cannot praise it too highly.

No attempt is made to deal with processes of manufacture in the section upon glass, and this is only natural in a work of this description. Opening with a short but interesting account of the historical development of the industry, and dismissing methods of production in a few lines, the section is mainly concerned with the physical and chemical properties of glass, and how these properties are related to the composition of the glass. The chief physical properties under review are specific gravity, hardness, viscosity, surface tension, elasticity, tensile strength, crushing strength, melting point, expansion, thermal conductivity, specific heat, refractive index, light absorption, fluorescence, electrical conductivity and dielectric constant. On the chemical side a very full account is presented of the many researches which have been carried out from time to time upon the influence of various reagents upon glass. It can be said with truth that this section is a mine of useful information and as an indication of the extent of our knowledge of the various properties of glass it leaves nothing to be desired.

The lists of references which follow each important section are noteworthy features of the book, and pay a striking tribute to the thoroughness and care with which Dr. Mellor has pursued his task.

Coloured Glass and Glass Decoration.

By JAMES H. GARDINER, F.Inst.P.

Much has been written and experienced in recent years of the defects in glass, and of the need for rational scientific procedure in all the departments engaged in its manufacture. Therefore, it is with feelings of relief and not a little pleasure that one can turn to another side of the question and be occupied with a more pleasing phase of the industry.

In coloured glass and coloured glass making we have what may be termed the poetry of the glass industry; there is something that attracts the eye and gives to the study and production of coloured vitreous material a charm of its own.

This is particularly striking in the case of Gems. The Oriental Ruby, the green Emerald, the violet Amethyst and the colourless Topaz, each with a distinct beauty of its own, have been produced in nature's laboratory by the addition or otherwise of traces of metallic colouring matters to crystalline alumina.

Apart from the intrinsic pleasure that is given to the worker in the production of coloured glass, and the knowledge that he has at his command a vast number of metallic substances capable of producing effects of both beauty and utility, he has also the wholesome couerousness of much uncertainty both in the production or reproduction of his desired result, even when equipped with rare formulæ, voluminous notes, and long experience, he is often confounded by the most astonishing differences between what he expects and what he actually finds at the end of his lehr!

This uncertainty in result is largely due to the rule-of-thumb methods that often hold sway in the glass house, but it can be very largely removed by careful and scientific control in all the chemical and physical manipulations involved in the production.

One of the objects of this article is to indicate from practical experience how such control can be best applied.

The production of coloured glass carries us back to the very origin of glass production. Long ages ago, beads, vases, and even lenses were produced in the far East and specimens have been found in the ruins of the lost cities of Babylon and Nineveh, the glass being generally of a faint green colour probably due to impurities in the material used.

The best early examples of true coloured glass have been found in Egypt, and they were produced there in the days when that wonderful old nation was at the zenith of its culture and art in the XVIII dynasty. Some truly beautiful specimens are to be seen in the British Museum of coloured glass found at Telel-Armana in the ruins of Akhnaten's "City of the Horizon," and they were probably made there about 3,500 years ago.

A photograph of one of these objects, an ornament in the shape of a fish is shown in Fig. 1.* Although there is no question as to the extreme age of this specimen, it shows no evidence of the decomposition that is usually found on the surface of ancient glass, the colours are all remarkably fresh. The prevailing tints are blue, green, turquoise and black, the lips and some other parts are ornamented with a canary yellow glass. The black would present no difficulty to the artist, for the manganese oxides were in general use as pigments in those times, the blues, greens and turquoise could easily be produced from the ores of copper and cobalt that are still mined in the locality. The source of the yellow which resembles the cadmium or uranium oxides is more difficult to trace, but we can see quite easily from this and similar objects produced in that period that the Egyptian craftsman had not only mastered the production of pleasing colours but was able to produce a thoroughly stable material which still stands as a permanent record of his skill.

The most prevailing colours of early Egyptian glasses were the greens, blues and blacks, particularly in the form of opaque enamels and the cases in the British Museum contain many fine examples of these glasses and glazes.

As has been indicated, a good deal of the interest in these specimens of early coloured glass lies in the stability of the material; the surface in many instances shows no sign of decay after 3,000 years.

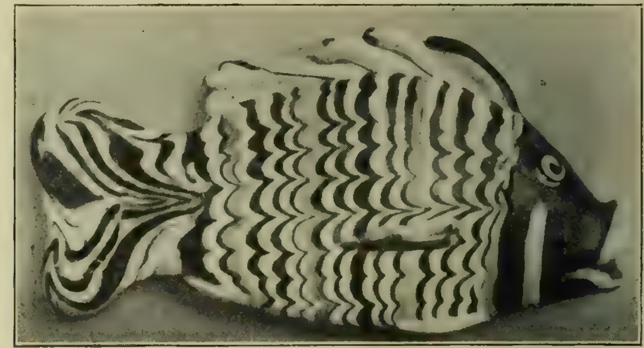


Fig. 1.
Ornament in Coloured Glass, Egypt, B.C. 1370. (Half size).

Stability is a matter of great importance to the maker of coloured glass, as his products are generally intended to be lasting. This is notably the case with the coloured glass used for architectural purposes, particularly in the glass used for the windows of churches and cathedrals, a subject that we shall refer to in detail later.

To return to ancient glass, in both coloured and colourless varieties there is usually an indication of instability in the form of a more or less beautiful irredescence of the surface. This has been caused by the condensation of moisture upon the surface, which, by prolonged action, has combined with the more soluble constituents of the glass, gradually increasing in alkalinity until the surface has become coated with a kind of film of alkaline silicate, which has eaten into it and produced a succession of pits and blisters, both of which shine with the irredescent colours due to thin films. A magnified image of such a suface of ancient glass is shown in Fig. 2, which somewhat resembles a painted surface that has been exposed to heat.

---

*From *The Life and Times of Akhnaton*, by Arthur Weigall. Thornton Butterworth, Ltd.

The importance of this subject to the maker of coloured glass can be seen in the next instance, that of a piece of fourth century cathedral window glass; this is from a sheet made by taking a light green metal and flashing upon one side a thick layer of ruby and upon the other a thin coat of bluish green. The ruby has stood up but the green has given way and its decomposition has evidently brought the metallic constituents, copper, nickel, and cobalt, into such a condition that they have been able to separate from the silica and form themselves into a system of concentric diffusion rings round nuclei of various shapes. Under the microscope these "periodic precipitations" as they have been called are extremely beautiful, and the specimen Fig. 3 is an interesting addition to a collector's cabinet, but it is manifestly a failure for the purpose for which it was intended. It is brought forward as an illustration of the care that is needed to be sure that the material produced should be stable.

In the production of coloured glasses for the purposes just stated, and indeed for all purposes, systematic tests should be made of the alkalinity of all melts. This instability in some coloured glasses is by no means unusual. The writer once met an artist in coloured glass who in exhibiting his productions, which were certainly fine as regards colour and appearance, found it necessary to lick the glass with his tongue and polish it with his sleeve to "bring out the colour."

Glass that is intended to be colourless often becomes coloured if exposed to sunshine for a length of time. This is probably due to the short ultra-violet radiation present in sunlight. Colour produced in this way is almost always amethyst or violet and is due to the presence of manganese that has been added to the batch as a "decolouriser."

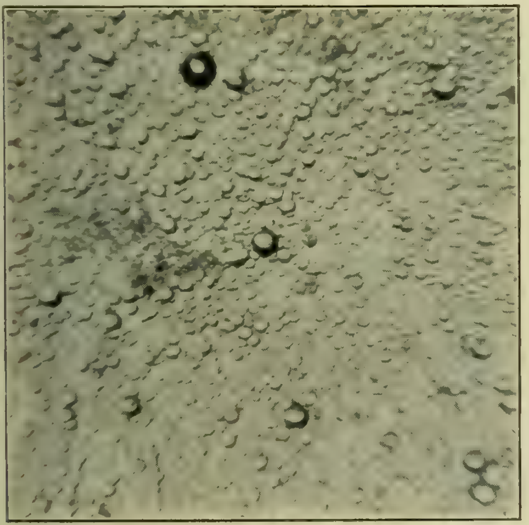


Fig. 2.
Pitted Surface of Old Coloured Glass. × 20.

The writer has in his possession some broken flint tumblers and similar objects which were sent from Australia. The glass has assumed throughout its mass a deep amethyst colour. As this action of solar radiation is of interest and importance the following particulars are quoted from a letter from the Geological Survey Laboratory of Perth, Western Australia, which accompanied them.

> "On the Coolgardie and adjacent gold fields which prior to 1893 were uninhabited desert, the ground is strewn thickly in places with fragments of tumblers etc. turned to all shades of purple. Where fragments are partly buried under the soil the exposed part is much deeper in colour than the unexposed . . . . by heating to redness and cooling the purpling was completely removed."

The effect is often seen in England in old windows that have received much sunlight although, of course, the colour is very faint.

The same colouration is produced in glass by prolonged exposure to X-rays and is also seen very distinctly in glass vessels that have been used in the preparation and storing of radium compounds. In dealing specifically with the present day production of coloured glasses we propose first to deal with the manufacture of the so-called antique glasses that are used for coloured windows, particularly for use in churches and cathedrals.

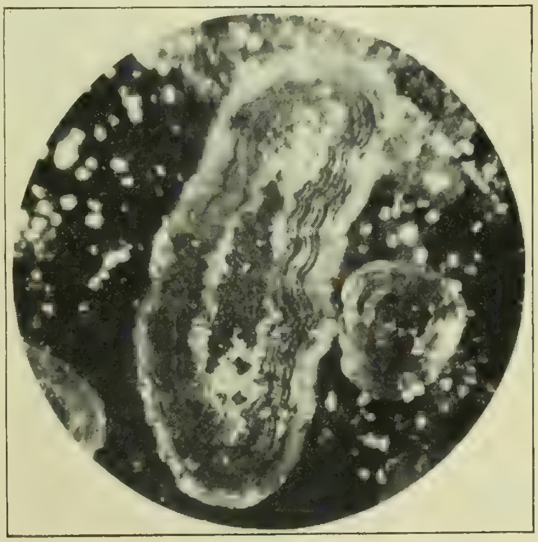


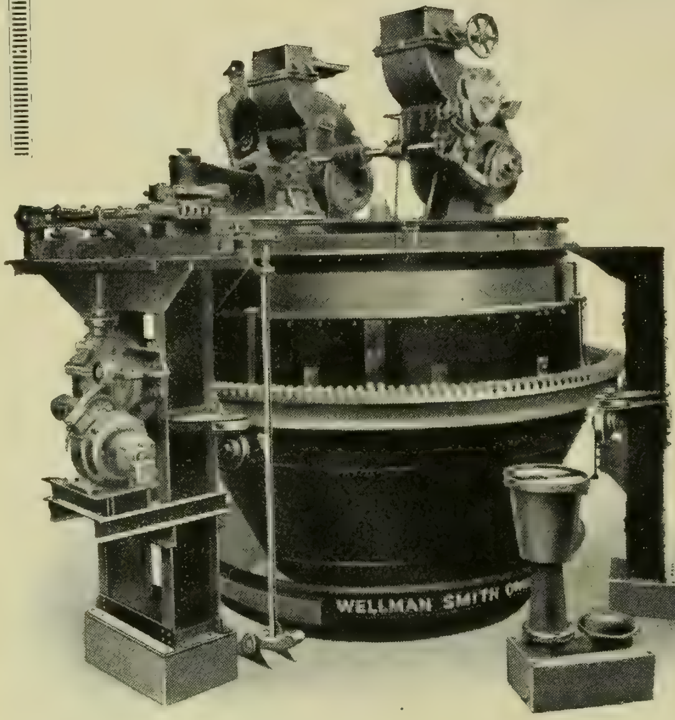
Fig. 3.
Periodic Precipitation. × 100.

This is an industry for which one or two glass-houses in England have become famous and the production is of a very special and select character. A golden rule for the work is the avoidance of "extremes." The colours as a whole must not be too brilliantly pure, and the glass must not be clear or plain. It must be remembered that the mediæval work which is taken as the ideal of present day attainment was carried out by individual hand labour without any of the modern mechanical aids, and for colouring materials the old world artists were not able to secure their oxides in such a state of purity as we can do

The WELLMAN Type L PRODUCER

WILL

REDUCE YOUR FUEL CONSUMPTION



VIEWING the present state of the Glass Trade and the keenness of competition in the home and foreign markets, you cannot but be impressed with the urgency of the need for cuts in the costs of production, and in particular, economy in Fuel Consumption.

That the Wellman Type L Producers are enabling Glass Manufacturers to cope with present-day conditions is amply evidenced by the increasing demand for these machines and repeat orders received. **A repeat order for 7 L Type Producers has just been received from a leading Continental Glass-works, bringing the total number of these machines supplied to this one firm up to 14.** We invite you to write us for full particulars of our Gas Machines, and to allow us to submit data showing how your Fuel Consumption may be reduced.

No. 10 TO GASIFY UP TO 4,000-lbs. COAL PER HOUR.
No. 8 TO GASIFY UP TO 2,600-lbs. COAL PER HOUR.

The WELLMAN SMITH OWEN ENG. CORP. LTD.,

36-38, KINGSWAY, LONDON, W.C.2.
WORKS :: :: DARLASTON, S. STAFFS.

Telephones—HOLBORN 2588/9. *Telegrams*—"PRINCIPIUM, WESTCENT, LONDON."

to-day by sending an order to a chemical warehouse. They were obliged to use crude and imperfectly understood mineral products and to a large extent had to prepare their pigments, as many of the old world painters are said to have done "out of their own brains."

The so called *whites* that are used for the uncoloured portions of the windows are produced from the standard colourless batch by adding varying proportions of old, partly coloured cullet, with traces of Ilmenite ore, or Zaffres (a crude form of cobalt). In this way a succession of faint tints may be prepared suited to the particular subject in hand. A good selection of these "whites" can be kept in store for selection by the artist. The sheets are generally made in the form of cylinders or "muffs" about 14 ins. long and six or eight inches in diameter. These "muffs" although they should not be made truly clear or cylindrical as would be the case if plain window glass were being produced, should not be too roughly made. Slight irregularities in thickness and shape are allowable and indeed desired, but this must not be overdone or the work becomes sloppy and is ultimately found amongst the "rejected" sheets in the store. After the cylinders have been made they are well annealed and are then passed on to the flattening shop. Here a cut is made in the direction of the length and they are passed into the flattening kiln where by means of wooden or iron tools they are opened out and formed into roughly flattened sheets and again annealed.

Coloured sheets are made by the method of flashing a thin layer of a deep colour on to the thick body of the muff; by rolling the ball, which is to form the muff, in crushed or powdered coloured glass and melting all together so as to give a coating in varying shades and streaks; or by making the muff entirely of coloured glass or "pot metal." An almost infinite variety of colours can be produced by these means. In the first process, that of flashing, very great care has to be taken that the metal of the coloured flash shall have the same physical properties, viscosity at a given temperature, and co-efficient of expansion, as the body of the muff, otherwise even with the most careful annealing, trouble will assuredly follow it into its ultimate destination, the cullet box. The fact is that many of the oxides that are used for colouring, particularly the oxide of cobalt used for all shades of blue· has a decided hardening effect upon the glass. It is advisable, indeed necessary, if waste of time and money is to be avoided, to carefully test the softening point and expansion of each pot of coloured glass that is made and so adjust its composition that its properties correspond and the metal with which it is to be used.

Details of this kind show the need for an intelligent works chemist and a good deal of daily testing and recording that to the superficial observer may appear unnecessary, but without which efficiency and success is impossible.

As regards the colours for the flashes or pot metals, the softer or mellow shades can be produced by the method of judicious blending. A variety of shades of green can be produced by making up the batch with pure copper oxide and adding varying small percentages of uranium oxide, nickel oxide, cobalt or Zaffres. In this way an infinite variety of tints can be produced from citron through the sage greens up to pure emerald and the beautiful bluish greens that play such a prominent part in some of the best modern windows.

The shades of blue can also be produced in the same way taking pure cobalt as a standard and softening down with chromic oxide or iron.

As regards yellows some very good colours can be produced by uranium or cadmium or both, but for the pure canary, deepening into orange it is usual to have recourse to the method of staining with silver—these silver stains are made by mixing silver oxide with kaolin or some such inert material and applying it as paint to the colourless glass, which should be rich in lime, and then heating it in the kiln to just short of softening point when the silver will combine with the glass, producing a shade of a depth that corresponds to the amount of silver present in the paint.

Although, as has been pointed out, the general rule in the production of church window glass is to avoid extremes there are certain portions of a window scene where the most vivid and brilliant colours are needed. These colours are mostly emerald green, pure blue, amethyst and particularly the rich purple ruby sometimes seen in old mediæval windows.

For the successful production of these colours no pains should be spared to secure purity and cleanness in every detail, special new and clean pots should be used for the melts, and it should be seen that the batch used would produce a clear and colourless melt. *Tested* material, particularly the oxide of copper which is often used in the form of copper scales, should be secured and care should be taken through all the operations of founding and working that no foreign matter should get into the melt.

The same may be said of the blue and amethyst; the oxides of cobalt and manganese that are used in these glasses can be obtained in a state of purity but it is always advisable to carefully examine and test each new supply of material as it comes into the works.

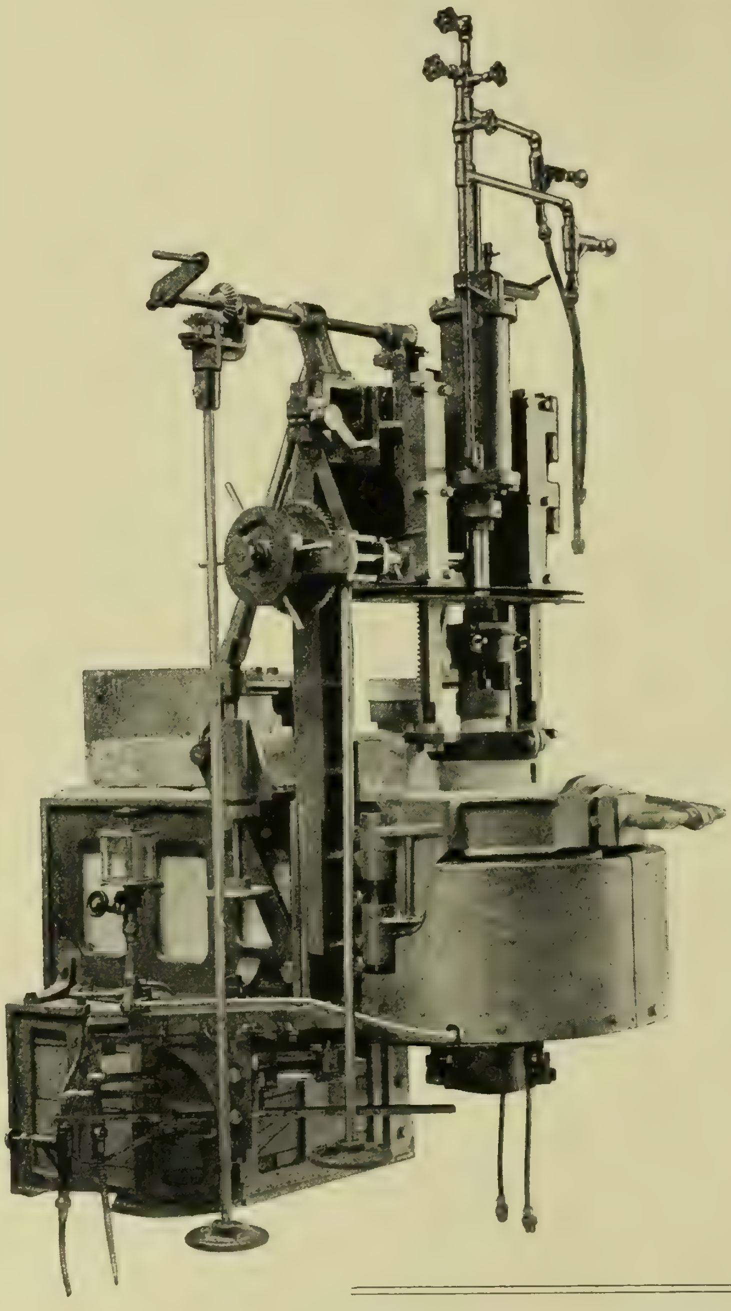
As regards ruby the writer wishes to draw special attention to the details in its production. It has often been suggested that the *secret* of how the old mediæval craftsman produced the magnificent ruby that is seen in some old windows has been lost, and in a certain way this is a fact, for how such results could be produced with the limited chemical knowledge and resources of those days is a constant puzzle, but there is no question that with proper care and patience, ruby glass can be produced to-day that is at least quite equal to any that has been made in the past.

It is, of course, well known that the best ruby coloration in glass is due to the presence of gold (although it is a curious fact that the colour of the Oriental Ruby is not due to gold but to chromium), and that the gold is in a colloidal state.

The researches of many chemists—of Faraday in particular—demonstrated that gold could be precipitated from its solution in such a finely divided state that the particles would remain suspended indefinitely, and that such colloidal solutions were of a magnificent purple or ruby colour when seen by transmitted light.

It is only by the greatest care that these solutions

The "RANKIN" Automatic Glass Feeder.



RESULTS JUSTIFY CLAIMS.

Claims without justification are futile.

The need for automatic production is admitted by every glass manufacturer. The question is—what mechanism can be installed with the assurance of the best results?

The "RANKIN" record is unrivalled in the Glass Feeder world. Its history is unique. In no instance has a "RANKIN" installation once installed been superseded. On the contrary, wherever it has been adopted, further installations have followed.

The latest proof of this claim is a repeat order for **TWELVE FEEDERS** from a Glass Manufacturing Company, who originally put in one Feeder for comparison with other similar devices. This we believe to be

THE LARGEST INDIVIDUAL ORDER EVER PLACED FOR AUTOMATIC FEEDERS

and represents a great triumph for an All-British Built Feeder.

The mechanism, material and finish are of the highest possible quality. The "RANKIN" Feeder is built for service and will outlast all others.

Demonstrations of the RANKIN AUTOMATIC GLASS FEEDER will be arranged by appointment.

For Illustrations, Descriptive details and terms apply to :

THE RANKIN AUTOMATIC GLASS FEEDER CO.,

1, CHARTERHOUSE STREET, LONDON, E.C.1.

Telegrams : Natiglaso, London. *Telephone Nos. :* Holborn, 140 and 141.

can be produced and rendered permanent. A variation in the strength or speed of the precipitant or the least accidental impurity causes the coagulation of the particles which take the form of either deep blue colour or muddy brown deposits.

The colour in gold ruby glass is due to this finely divided gold and by means of the ultra microscope the separate minute particles of metal are quite easily seen.

It is easy to understand that to get the best results in the production of gold ruby glass very great care is necessary in all the operations, in fact it needs to be watched much as a cat watches a mouse, from the time of mixing the ingredients until the glass leaves the workman's hands. The most suitable batch for this glass is a soft lead mixture containing an excess of antimony and arsenic and all the materials used should be in the highest state of purity obtainable. Care, too, should be taken that no trace of foreign matter should get into the batch during mixing. It is a good plan to reserve special mixing trays and tools for the gold batch and see that they are kept scrupulously clean and not used for any other glass; if, as is generally the case, hand mixing is employed, the mixing shovel and other tools should be of wood and not of metal. The preparation of the gold solution also needs care. " Fine " gold should be used and it is best to obtain it in the form of thin foil as this is more easily dissolved in the acids. Pure, re-distilled nitric and hydrochloric acid should be used in the proportion of two parts hydrochloric to one of nitric and when all the gold is dissolved it should be slowly evaporated until it becomes of a dark treacly consistency; it can then be dissolved in distilled water and made up in solution of known strength for use.

A usual strength for the gold is one ounce of metallic gold to two hundred pounds of batch. The necessary amount of the gold solution prepared in the way described can then be sprinkled over the prepared batch and the whole very thoroughly mixed using only clean wooden tools for the purpose, it should at once be " charged " into a new pot, stoppered, and the stopper well luted (taking care that no clay gets into the pot in the process). The pot is not opened until the metal is finished and it is then cooled off and worked immediately, the metal should be clean and in thickness a quarter of an inch or so perfectly colourless. Thick lumps will be of a faint straw colour.

The metal although soft can be easily worked and is formed into sheets in a way most suited for the purpose to which it is to be used. For window work it is usual to form it into square boxes of irregular thickness which is easily cut into flat plates. The annealing needs care and the temperature of the lehr or kiln should be lower than that used for ordinary work on account of the low melting point of the glass, otherwise " colouring " may take place during annealing which is undesirable.

When the pieces of ruby glass have been cut to the shapes for the purpose for which they are to be used comes the operation of colouring; this is done by placing the slabs of glass in a kiln and slowly raising the temperature almost to the softening point. If the glass is watched during this rise in temperature it will be seen to pass from the faintest and most beautiful of rose tints, through the rare pigeons-blood ruby to the rich deep purple-ruby that once seen is never forgotten. If the firing is pushed beyond this stage the metal becomes blue and if still further forced the particles of gold so coagulate that the metal may become " rusty " and all its beauty is lost. Of course the material can be removed from the heat at any of the stages just described and after cooling no further change occurs.

Ruby glass, once made and coloured in the way described, is remarkably permanent and may be heated and melted repeatedly without any further change in colour, and for many purposes in the glass-house it is convenient to form the metal into rounded lumps of about one and a half inches in diameter and four inches long. These " lumps " as they are called when they leave the workman's hand are colourless and are put into a special kiln in which the heat is slowly raised until they " colour " when they are cooled and stored ready for use.

This operation is less refined than the process of colouring slabs that has just been described, and indeed in some cases it is done so roughly that much of the real beauty and use of the glass is lost.

Such a faulty production, however, well repays careful examination and furnishes a fund of useful information. A photograph of a section 1 m.m. thick cut from the centre of a " lump " of ruby glass made in this way is shown in Fig. 4; in the picture the dark parts correspond to the ruby colour and the white spiral is colourless. First of all it is evident that the heat has been very unevenly applied, one side being much more deeply coloured than the other. The floor of the kiln upon which the lump rested was evidently much hotter than space above it. The spiral lines and central point have a story to tell for those who can read it. The lump had been formed by " gathering " the metal at the end of a blowing iron by the method of " turning " or " twisting " and it is clear from the picture that the uncoloured portion corresponds to the striæ that are always formed when gathering in this manner, and this may be due to a layer on the surface very rich in alumina by action of the glass upon the pot surface, although it hardly seems possible that this can fully account for it.

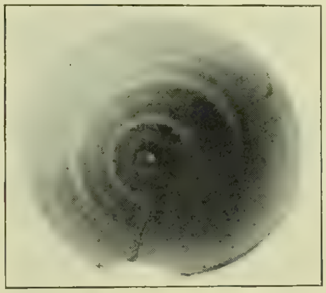


Fig. 4.
Section of " Ruby Lump." Full Size.

One other thing may be learned from this " faulty " production, and that is that a gold containing glass might be made use of as an indicator of temperature. Rods of this glass fixed in different positions in the kiln or lehr would *show* the variations of temperature in different positions.

[*To be continued.*]

PARKINSON & SPENCER, Ltd.

Ambler Thorn Fireclay Works,
HALIFAX, YORKSHIRE.

ESTABLISHED
1800.

Telephone : No. 1207.
Telegrams : Parkinson & Spencer, 1207 Halifax

Manufacturers of Refractory Goods of every description for the Glass industry, viz:

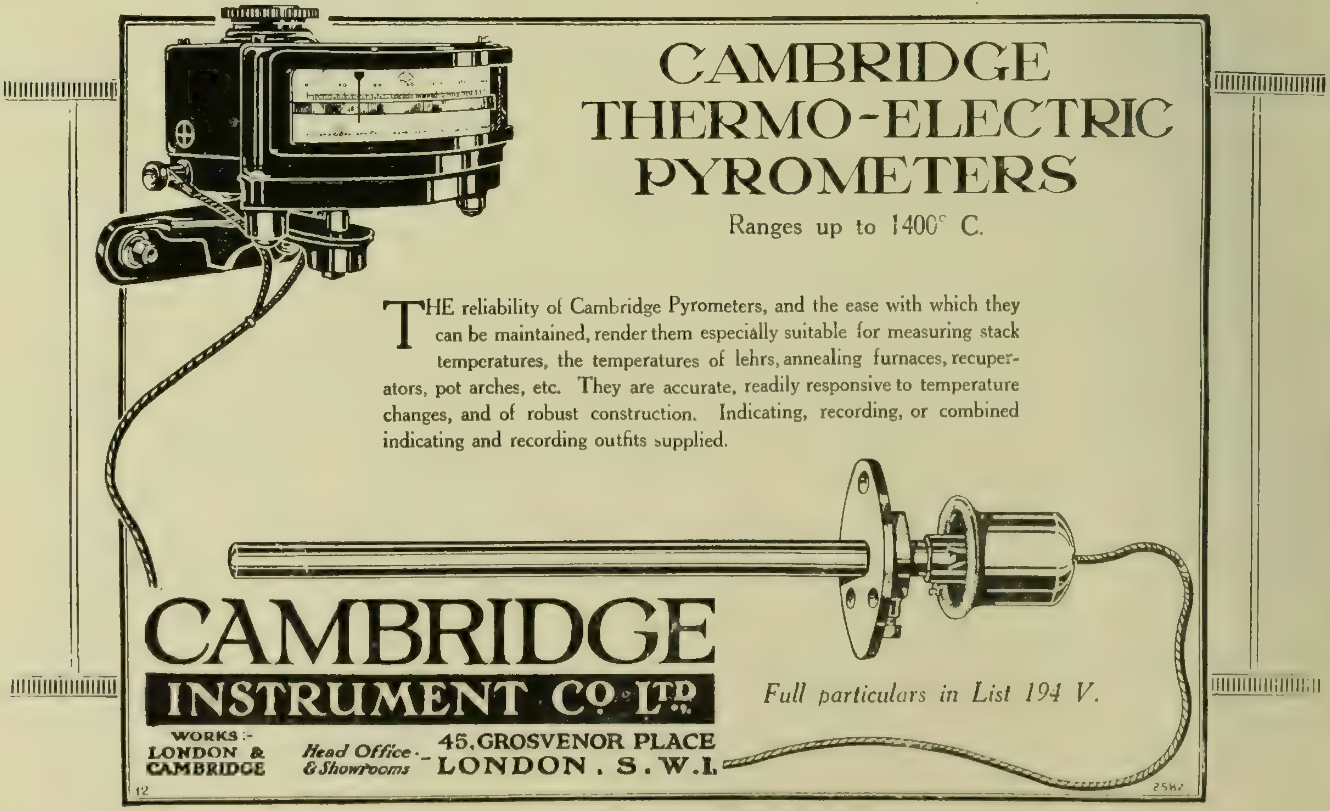
GLASS-HOUSE POT CLAY, FIRE CLAY, FIREBRICKS, TANK BLOCKS, BINDERS, etc.

Our Tank Blocks are unsurpassed for quality and durability.

WE SPECIALIZE IN BEST POT CLAY MATERIAL.

New Plant recently erected for the cutting and dressing of Tank Blocks to any dimensions.

FAVOUR US WITH YOUR ORDERS AND YOU WILL BE SATISFIED WITH RESULTS.



CAMBRIDGE THERMO-ELECTRIC PYROMETERS

Ranges up to 1400° C.

THE reliability of Cambridge Pyrometers, and the ease with which they can be maintained, render them especially suitable for measuring stack temperatures, the temperatures of lehrs, annealing furnaces, recuperators, pot arches, etc. They are accurate, readily responsive to temperature changes, and of robust construction. Indicating, recording, or combined indicating and recording outfits supplied.

CAMBRIDGE INSTRUMENT Co. LTD.

WORKS:-
LONDON & CAMBRIDGE

Head Office & Showrooms - 45, GROSVENOR PLACE
LONDON. S.W.1.

Full particulars in List 194 V.

12

2587

The Society of Glass Technology.

Two Day Meeting in Manchester.

The eighty-sixth meeting of the Society which was held in the College of Technology, Manchester, extended over two days, January 20th and 21st. The first session was devoted to a discussion on "The refractory Materials of Use to the Glass Industry," while the papers given at the second session dealt with durability tests on bottle glasses, and the homogeneity of glasses melted in pots.

The meeting was very popular judging from the muster of members, and a very friendly atmosphere prevailed throughout. Many members took tea together at the College after the first session, and so rife was good humour that a party was quickly made up, of those staying overnight in Manchester, to visit a pantomine. This digression from the usual routine of business evidently acted as a tonic, for a keen, lively party assembled quite early the following morning to visit the works of Messrs. Metropolitan-Vickers Electrical Co., Ltd. The morning passed all too quickly, for the study of a large works organisation and the successful application in works practice, of results obtained by scientific research, proved very fascinating, as well as instructive. Truly, the darkness was shattered by a brilliant light, not to be forgotten.

The good times of the meeting did not end with this visit, for a return was made to the Grand Hotel, where the Mayor of Salford was entertained to luncheon. In proposing the toast of the Society, the Mayor paid tribute to the splendid work already done, and wished the Society every success in the future.

Replying to this toast, Mr. Walter Butterworth (Senior) spoke very highly of the work done by the Society, and also the Department of Glass Technology, of the University of Sheffield. He regretted that Manchester had not seen the great opportunity years ago, but was glad that Sheffield University had displayed keen foresight, and created the Department, which rendered such signal service to the industry by its own original research, and also by the preparation of the Society's Journal which contains valuable abstracts of other relevant research.

The Eighty-Sixth Ordinary Meeting.

First Session.

The chair was taken by the President, Mr. T. C. Moorshead, and four new members were elected to the Society, including one from Berlin, and another from Holland.

The discussion on refractory material was opened by Mr. E. A. Coad-Pryor, B.A., in a contribution entitled "The Use of Refractories in the Glass Industry."

The speaker pointed out the value of a periodical review, a stock-taking of the behaviour of refractories, and any improvements achieved. He thought that a meeting of manufacturers, to discuss failures, and new proposals, might well be held annually, and in order to set the ball rolling on this occasion he intended to relate some of his own troubles. At one time, working on a small experimental scale, he came to the conclusion that reliable information on the behaviour of refractories could only be obtained from large scale work, while his results from large scale observations led him now to think that work on a small scale was the thing.

He spoke of the making and firing of tank blocks which were used in the building of three different furnaces. In two cases the blocks were failures, while in the third, they were quite satisfactory; therefore, a type of block should not necessarily be condemned, on its behaviour in one works.

In other tests, blocks made from mixtures containing widely different percentages of grog, and built into one furnace, exhibited not the slightest difference when a post mortem examination of the tank was made. Great differences were observed, however, in blocks from different makers, but having the same porosity, refractoriness, and of which the firing temperatures were very nearly the same.

The mode of operation of a furnace and the kind of clay used were, he thought, very important factors in the behaviour of a refractory. The specification which had previously been given for tank blocks needed revising, and the speaker advocated new refractoriness and after-contraction tests.

Failures due to underfiring were not as common as formerly, but flaws due to faulty moulding still cropped up. A specimen of a block picked out during a trimming process, and exhibiting a large cavity, was shown. X-ray examination of blocks, so as to detect any flaws was advocated, the cost of a suitable equipment being given as £350-£500. Mr. Coad-Pryor thought that users would pay 10s. per ton more for blocks examined in this way, and a central testing station might well be set up.

He suggested that makers of blocks should supply some of a standard size to be built into many furnaces, for trial runs, in order to gain wider experience as to their behaviour. Again, a small experimental tank might be built and after operation a committee deputed to the work, might hold an examination, and give a report on the relative value of the various blocks employed.

With regard to the much discussed refractory, sillimanite, Mr. Coad-Pryor cited an experience in which sillimanite blocks, placed above the flux line, in contact with silica blocks, became red hot on the outside in six weeks time. He thought, however, that judicious use of the material in certain parts of a furnace, should prove satisfactory.

After thanking Mr. Coad-Pryor, the President said that he extended his sympathy to the manufacturers of refractories, when he heard discussions such as the one proceeding. In regard to the X-ray examination

STEIN & ATKINSON LIMITED,

Telephone:
VICTORIA
7325-6.

47, VICTORIA STREET, LONDON, S.W.1.

Telegrams :
METASTEINA,
SOWEST, LONDON.

SPECIALISTS IN GLASS WORKS EQUIPMENT.

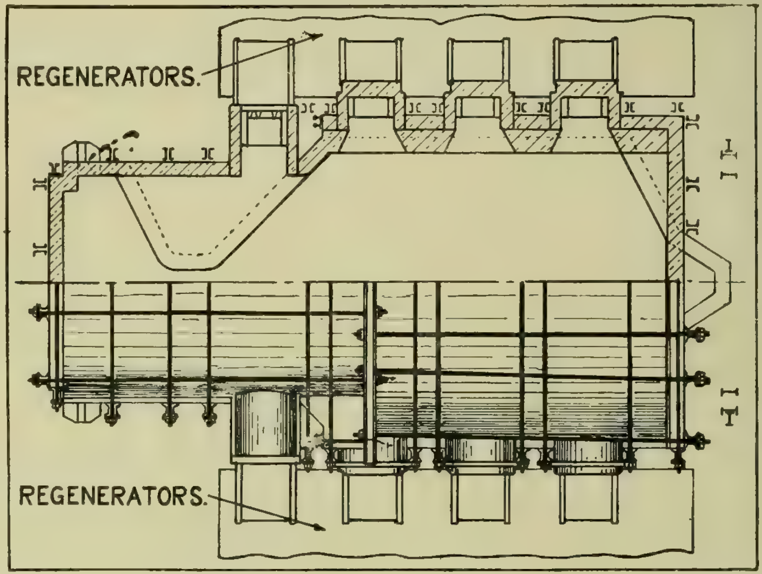
Glass Tanks.

Open and Muffle Type Lehrs with Patented Design of Conveyor Belt.

Chimneys and Bins, Reinforced Tile Construction.

Silicate of Soda Furnaces.

Caustic Pot Settings.



Stein Type Pot Furnaces.

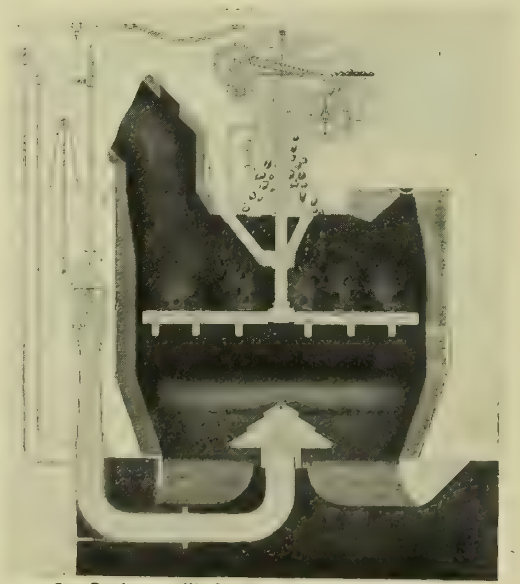
Recuperative Revolving (patented design) Pot Furnaces for Owens Machines.

Complete Batch Storage, Mixing and Handling Equipment.

TORPEDO TYPE GLASS MELTING FURNACE

Built Under License With The United Glass Bottle Manufacturers Ltd.

REDUCED FUEL CONSUMPTION — INCREASED MELTING CAPACITY
REDUCED REPAIR COSTS.



Gas Producer with Chapman Floating Agitator.

CHAPMAN AGITATORS FOR NEW OR EXISTING GAS PRODUCERS

Over 1,100 Installed. - 160 in Great Britain.
75% Being Repeat Orders.

Savings up to :—

COAL ... 25%.
LABOUR ... 75%.

THE CHAPMAN COMPLETELY MECHANICAL PRODUCER.

THE CHEAPEST MECHANICAL PRODUCER ON THE MARKET TO INSTALL AND MAINTAIN IN WORKING CONDITION.

CATALOGUES SENT ON REQUEST.

of blocks any method of detection of hidden holes and fractures would help to prolong the life of a furnace, and he would be very glad of some such method.

Mr. G. V. Evers said that the specimen block shown by Mr. Coad-Pryor was the result of bad workmanship, and inexcusible. He asked whether X-ray examination would reveal the presence of fine thread fissures, which may exist in the " green " block as a mere " layering," produced by a bubble of air, or moisture, opening out on " burning." He would welcome any means of detection and elimination of these thread fissures.

With regard to sillimanite, he concluded from his own work and what he read, that the material was of distinct use above the metal line, but that on this line, it gave disastrous results in many cases. He suggested that sillimanite did not obey the same laws as clay.

Mr. Milton Asquith said that it was absence of blocks, i.e., at the joints of a tank, where 25 per cent. of the trouble arose.

Mr. W. J. Rees pointed out that the previous refractories specification mentioned by Mr. Coad-Pryor was only a tentative effort, and he would be glad to know why it failed, as refractoriness and after-contraction tests were specified. Further, the character of the porosity, a very important factor, was also specified, as smallness of pores tended to reduce glass absorption. He agreed that the time was ripe for overhauling the specification, but it was difficult to obtain information of sound value.

The installation of an equipment for X-ray examination was desirable, and, by means of the X-rays, air-pockets could be detected, but he maintained that users of refractories would not pay more for the examined article. They bought in the cheapest market. He was surprised that wider use was not made of the casting process, as, speaking generally, such blocks were freer from air-pockets.

Mr. W. A. McIntyre testified to the true indication of the presence of black cores, and large holes by means of X-rays, but he did not think that small fissures would be detected. He had definite knowledge of experiments made by an experienced caster, from which it was concluded that cast blocks were less free from air-pockets than moulded blocks.

Mr. G. Simpson spoke on the satisfactory life of blocks containing small fissures. He had known blocks containing rainbow-like cores last for five months, whereas some with black cores lasted twelve months. With an air cooled tank, he found that after a certain thickness had been reached, the joints did not give any trouble, and the blocks that had failed were not well burned. Feeder parts that appeared the " less burned," proved the more satisfactory. He wondered whether X-ray examination of blocks would eliminate the need for air-cooling on a tank.

Mr. F. W. Adams showed samples of refractories taken from mechanical feeders. These appeared to be quite satisfactory, yet gave rise to a " boil " in the metal. On analysis, the blocks were found to contain 3.2 per cent. Fe_2O_3, with no free iron. Bubbles were actually seen to be arising from black centres, which acted as nuclei for gas bubble formation. Clay free from such specks was quite satisfactory.

Dr. S. English asked Mr. Coad-Pryor if he could advance any reason for the failure of a type of block in the two furnaces, but not in the third. He also inquired as to the kind of glass used, its colour, and composition, the rate of heating up of the furnaces and the rate of working out.

With reference to the disastrous results obtained by Mr. Coad-Pryor with sillimanite he said that it was definitely known that some clays would bond satisfactorily with sillimanite while others would not. Did Mr. Coad-Pryor use a satisfactory clay or was the sillimanite only semi-bonded? Well-bonded sillimanite was as resistant to corrosion by glass, as was clay. Sillimanite should not have interacted with silica.

Mr. B. P. Dudding said that not enough reliable large scale work was done. Furnace gases had a distinct effect on refractories. He hoped that money, if available, would be spent on high class control, that the field of experience would be widened, and that a stimulus be given to men doing pure research.

Mr. Coad-Pryor replied to the many questions raised.

Mr. W. Angus McIntyre presented two papers as a basis for discussion, the first of these being entitled "**Some Experiments upon the Development of Sillimanite Refractories for Glass.**"

The speaker gave results of early experiments which showed that, in order to obtain satisfaction in the use of sillimanite, careful selection must be made of the bonding clay. Ball clays were unsuitable, and the

(*Continued on page* 105).

GLASSWORKS PYROMETERS.

FOSTER PYROMETERS
give efficient service under the most severe conditions.

MAY WE SEND YOU PARTICULARS?
Ask for Books Nos. S30 and S31.

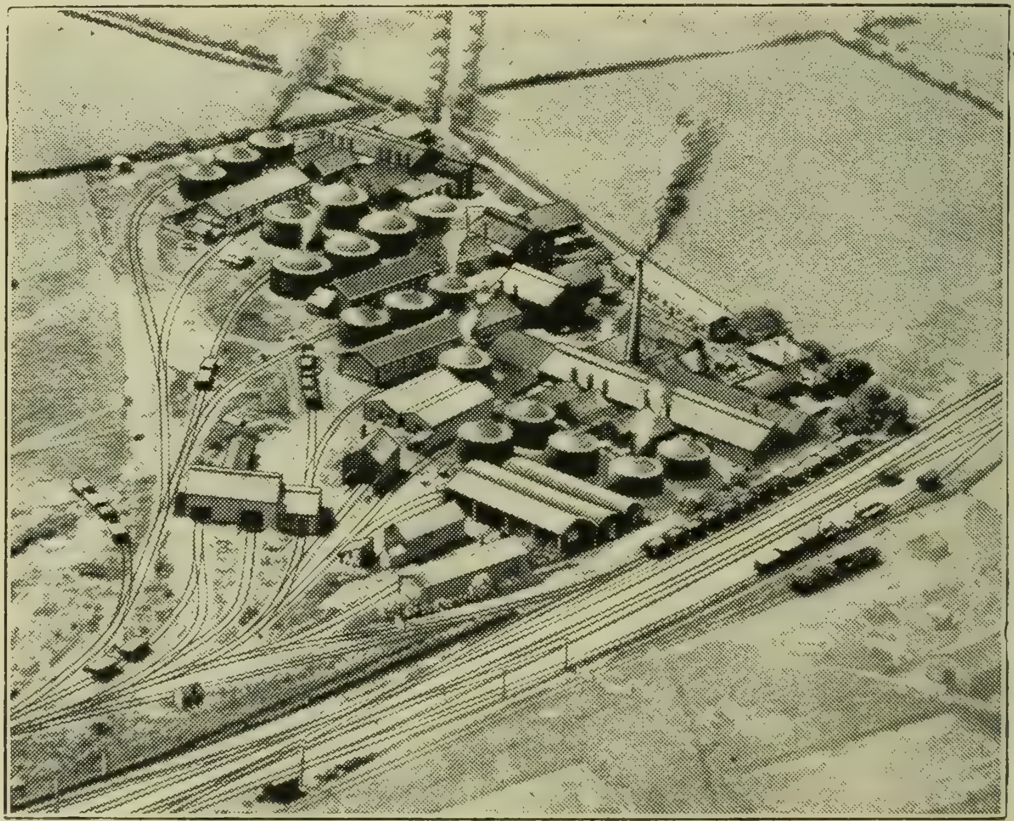
FOSTER INSTRUMENT CO.,
LETCHWORTH, HERTS.
"The Pyrometer People,"

Telephone : Letchworth 26.
Telegrams : " Resilia," Letchworth.

THE MOST DURABLE **BRICK**
MADE FOR **GLASS FURNACES.**

STEPHENS SILICA "C"

EXTREMELY REFRACTORY, TOUGH AND DURABLE.



VIEW TAKEN FROM AN AEROPLANE.

Kiln Capacity 1½ Million Bricks. Works Cover over 9 Acres.

SUPER SILICA CEMENT for setting SILICA BRICK.

Used by most of the principal GLASS WORKS.

STEPHENS & CO., KIDWELLY.

Society of Glass Technology (Continued from page 103).

final choice lay with a Stourbridge Old Mine Clay, which "developed a good crystalline bonding of secondary sillimanite after two hours' firing at 1420° C."

Test pieces of blocks were immersed in soda-ash, salt cake, potash-lead, and fluorspar batches, and were found to be more resistant that ordinary blocks. Special soda-lime glasses were melted at temperatures above 1500° in small pots made from a selected mixture, and these pots showed very little sign of attack.

The author described a sillimanite siege for pot furnaces, which had yielded good results in practice. A mixture containing coarse sillimanite was thoroughly rammed on to a prepared surface, then a fine-grained surface compound was applied, and after drying, was ready for use. A preliminary firing was, however, to be recommended.

The second paper by Mr. McIntyre was entitled **"The Manufacture of Some Experimental Tank-blocks and their Behaviour in Service."**

A small, experimental tank furnace was described, in which blocks to be compared were built. The design of the furnace was chosen to give, as far as possible, similar conditions throughout, and the working was very carefully controlled.

The chief defects to be eliminated from the blocks were incorrect size and shape, laminations, poor bonding, under-firing, and black-coring. High grog content of the mixture, a new moulding process, and an efficiently controlled method of firing were at once found to be desirable.

Using two fireclays, two series of blocks were prepared, one containing sillimanite, the other, silica. The siliceous series was sub-divided into two sections, according to whether use was made of graded or ungraded grog.

After souring for a short time, the batches were moulded by a pneumatic hammer, dried, and then fired very rapidly. Blocks supplied by manufacturers were tested in the same furnace, which was run on a soda-lime batch for six weeks. When examined, the sillimanite blocks were almost unattacked, while the siliceous ones were far superior to all except one commercial variety. The remaining commercial blocks exhibited most of the defects mentioned above.

"Note on a Design for a Glass Pot-board," by Mr. F. Winks M.Sc.Tech.

The author described a new pot-board which he had designed with a view to eliminating the cracks which develop in the hoods or bottoms of closed pots, on drying. The main feature of this board was a movable central strip. The two sections were mounted on ball bearing contacts. Shrinkage could thus take place without the clay being dragged over the grog particles.

Mr. G. V. Evers said that cracking in pot crowns was often due to the excessive weight of the hood, and no change in type of the pot board could eliminate this. He spoke of loose mouthpieces which he already had in use and which were put into position after the pot was put in the furnace.

Second Session.

In the absence of the President, the chair was taken by Mr. J. Connolly, and two papers were presented:—

(1) **"Some Tests on Bottle Glasses with the View to Prescribing Standards of Composition,"** by H. S. Blackmore, B.Sc. Tech., and Prof. W. E. S. Turner, D.Sc.

Professor Turner, who read these papers, remarked on the great number of tests which could be applied to the determination of the durability of glass bottles by scientific workers, and on the need for a rapid method which could be applied by an unskilled person under works conditions. He now presented an interim report on work done by five members, working in three different laboratories, at Sheffield, Charlton, and the National Physical Laboratory.

Five sets of bottles of different compositions were made in two factories, and tested by the small band of workers, the tests employed being:—

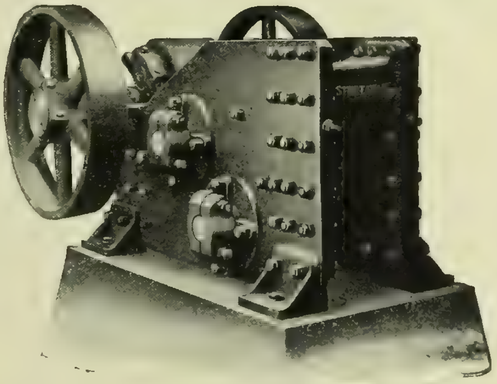
(1) Boiling a 0.1 per cent. solution of narcotine hydrochloride in water, in the bottle, with examination every few minutes of the solution for any signs of a deposit.

(2) Boiling the bottle for six hours with distilled water, measuring the amount of soda extracted, and noting the final appearance of the bottle.

(3) A colour test, in which a solution of N/5,000 H_2SO_4 was charged into the bottle, with an indicator such as phenol red, or bromo-thymol blue, and on boiling, the time taken to produce the red or blue colour indicative of excess alkali was noted.

The results obtained by all the workers with the

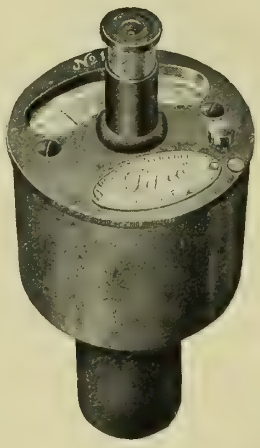
[Continued on page 107).



For Breaking down Glass Cullet

the Sturtevant Roll Jaw Fine Crusher is the ideal machine. It can be adjusted to give a coarse or fine product, and the mechanism ensures smooth running, slow speed, and the minimum of power.
Write for free leaflet G.L. 1541.

STURTEVANT
ENGINEERING
Co. LTD.
149 QUEEN VICTORIA ST LONDON E.C.4.



Write for our NEW LIST C 32

describing our unique

PYRO RADIATION PYROMETERS

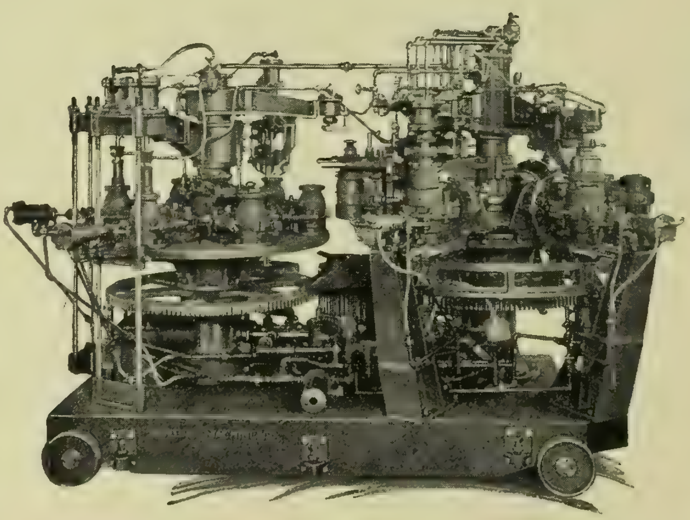
for Indicating or Recording.

Instantaneous, Simple, No Maintenance Cost,
Reduced Prices.

BOWEN INSTRUMENT CO.,

9, NEWTON ROAD, LEEDS.

DISTRICT REPRESENTATIVES: R. Gates, A.M.I.E.E., 11, Hill Crest Road, Moseley, BIRMINGHAM.
Jas. Sturrock & Co., 116, Hope Street, GLASGOW.



The New O'Neill No. 44 Blowing Machine.

A well built, high speed blowing machine with a range from 6 oz. to 40 oz. in capacity. Operating speeds up to 23 per minute depending on the class of ware being made. Have our London representative give you the details.

THE O'NEILL MACHINE CO.,

TOLEDO, OHIO, U.S.A.

LONDON OFFICE: 10 SAVOY ST., STRAND, LONDON, W.C.2.

Society of Glass Technology.

(*Continued from page* 105).

narcotine hydrochloride test were in fair agreement, and the bottles made of glass containing less than 8 per cent. CaO were definitely classed as unsatisfactory.

In the boiling test (2), there was not such good agreement in results. Professor Turner emphasised the difference in results arising from variation in temperature of boiling water due to change in barometric pressure at the time of experiment. This boiling test was, therefore, not recommended for works use until more work was done with it. The colour test gave results in agreement, and the grading of bottles resulting from its use was the same as when the narcotine hydrochloride test was used.

The tests showed definitely that glasses containing less than 8 per cent. lime, with more than 18 per cent. soda, were unsatisfactory.

Mr. E. A. Coad-Pryor seemed to think that the micro-agitation of the boiling water had more influence on the results than had any slight difference in temperature. He testified to the necessity for strict observance of all details of test. He suggested that check analyses be run on bottles showing peculiar behaviour. From personal knowledge he could say that users of bottles were now testing them, and he was glad of that fact.

Mr. F. W. Adams asked whether the treatment in the mould rendered the outside of the bottles more prone to attack than the inside, and whether the narcotine hydrochloride test could be applied to the outer surface.

Miss V. Dimbleby asked whether any tests had been made by boiling the narcotine hydrochloride alone in, say, platinum, in order to determine whether any decomposition took place under prolonged heating, in the absence of alkali. Such decomposition had been found to take place with some alkaloid salt solutions, but she had not observed it with narcotine hydrochloride, boiled for some 45 minutes in platinum.

She also enquired how the bottles were heated up in test (2), as any difference in time taken to reach the boiling point would tend to affect the results obtained with poor bottles?

Professor Turner replied to these enquiries, then passed on to the next paper.

(2) **"The Homogeneity of Glasses melted in Pots under Manufacturing Conditions,"** by Miss E. M. Firth, B.Sc., and Professor W. E. S. Turner, D.Sc.

Several factors operated against homogeneity in glass, e.g., the varying grain size and density of the raw materials, their different melting points, and temperatures of decomposition.

The Professor referred to the observation made by Faraday as far back as 1829, that a definite difference in density obtained between the top and bottom layers of a pot of optical glass. Again, in 1900, Jackson and Rich came to the conclusion that lighter and denser parts existed in glasses. It seemed desirable, therefore, to test a number of glasses melted under definitely specified commercial conditions, and the Professor now presented results obtained in such an investigation.

Several kinds of glasses were procured from different factories, and included alkali-lead oxide glasses, soda-lime silica glasses, potash-lime-silica, and a potash-lime-baryta-alumina-boric oxide glass. The samples were taken from the pots in the following order: (1) from the top just when the glass was ready for working, (2) half-way down the pot, and (3) from the bottom layer, about 4 ins. from the bottom of the pot.

The chemical composition of each sample was determined. Apart from a very slight decrease towards the bottom of the pot, in the boric oxide content of the complex glass quoted, the results showed that non-stirred glasses produced commercially, exhibited a surprising homogeneity of composition throughout the pot.

In reply to a suggestion made by Mr. E. A. Coad-Pryor, that samples taken from cordy metal should be tested, Professor Turner pointed out that no special specification was made as to the state of the glass when the samples were taken. One reason why the work had been started, was an enquiry into the cause of cords.

The Next Meeting.

The next meeting of the Society is to be held in the Department of Applied Science, the University of Sheffield, on February 17th, 1926. Several papers of general interest are to be read, and we understand that some of the subject matter will be as follows :—

(1) The Mixing of Batch.
(2) The Functioning of Arsenic in Glass.
(3) The Influence of Small Amounts of Impurity on the Viscosity of Glass.

V.D.

Now Ready!

Volume II

Industrial Furnaces

By

W. TRINKS, M.E.

Fuels, Furnace Types and Furnace Equipment; Their Selection, and Influence Upon Furnace Operation.

The ONLY BOOK *in* ENGLISH
available on this important subject.

405 PAGES. 292 FIGURES.
27/6 net (VOL 1, 22/6 net)

GLASS PUBLICATIONS LTD.,
TALBOT HOUSE,
ARUNDEL STREET, STRAND,
LONDON, W.C.2.

TELEGRAMS:
"GLASMACHIN, ESTRAND, LONDON.
CABLES:
"GLASMACHIN, LONDON"
CODE:
BENTLEY'S.
TELEPHONE:
CENTRAL 5985.

C. SAXTON, A.M.I.E.E., M. IRON AND STEEL INST., Etc.

CONSULTING ENGINEER

Talbot House,
Arundel Street,
Strand, London, W.C.2.

BOTTLE MOULDS

ORDER YOUR MOULDS FROM

E. LUNN & Co., MOUNT STREET, GLASGOW.

Largest MAKERS of MOULDS in the UNITED KINGDOM

Quick Deliveries and Complete Satisfaction Guaranteed.

MOULDS FOR ALL TYPES OF MACHINES SUPPLIED

ALL MOULDS MADE OF CHILLED CASTINGS ONLY.

Telephone — WESTERN 2792.
Telegrams— GLASMOLD, GLASGOW.

ONE OF OUR RECENT TESTIMONIALS—

"We have one set of Ordinary Round Quart Moulds which you supplied to us which have been working for 2½ years. These are still in perfect condition, showing no cracks or any other flaw in the metal. They have been working almost continuously for the above period, only being off the machines for a week or two at a time. We have also other moulds in Square, Oval and special shapes which have been working quite as long as the Ordinary Round Quarts, although not so continuously, and these also are in perfect condition. We have always found your moulds more satisfactory than any others, and the metal you use is much more durable than any supplied by other firms."

Reference on our Testimonial File : A.B. 91.

TRADE "TWENTY MULE TEAM" MARK
BRAND

BORAX
BORIC ACID
Guaranteed at least 99·50 per cent Pure
BORAX GLASS

GLASS.

Glasses of which Boric Oxide is a constituent have a low co-efficient of expansion, endure rapid changes of temperature, and resist the action of steam, water, and certain chemicals. In glassworks practice the B_2O_3 is introduced by including Borax or Boric Acid in the batch.

These durable glasses are used for laboratory-ware, cooking utensils, illuminating ware, battery jars, miners' lamps, water-gauge tubes, thermometers, insulators, etc. Small quantities of Boric Oxide increase the durability of lead oxide glasses, whilst as an ingredient of container glass it provides resistance to the corrosive action of acid juices and reduces breakages when the charged vessel is heated (as in the instance of preserved meats).

A 40pp. treatise, "*Boric Oxide as a Constituent of Glass,*" gratis on request.

Our Technical Department welcomes correspondence regarding the uses of Borax and Boric Acid in the ENAMELLING, GLASS, and POTTERY Industries.

Telephones ROYAL 1450-2. ROYAL 6683.
Telegrams COLEMANITE, TELEW, LONDON.

BORAX CONSOLIDATED, LIMITED.
16, Eastcheap, *London*, E.C.3.

TRADE NOTES.

According to a D.O.T. Report just issued, Algeria imported 895 tons of plate glass and mirrors, valued at 3,541,000 francs during 1923 and 700 tons valued at 1,632,000 francs during 1924. Other glassware imported during 1923 amounted to 1,170 tons with a value of 6,160,000 francs and during 1924, 1,419 tons valued at 7,592,000 francs.

The same Report gives the imports of glassware (including insulators) into French Morocco as amounting to 2,305 tons with a value of 7,000,000 francs during 1924. Of this Belgium supplied 1,395 tons and France 798 tons.

◆ ◆ ◆

The British Industries Fair will be held simultaneously at the White City, London, and also in Birmingham, from February 15th to 26th inclusive.

◆ ◆ ◆

By an Order issued on January 19th by the Minister of Agriculture and Fisheries, the situation which had arisen in connection with the return of packages containing straw, has been cleared. The new Order states that:—" No hay or straw, from any source, which has been used for packing purposes, shall be brought into contact with any animal in Great Britain, or be removed from any premises, except used as packing or for the purpose of destruction or of being returned in a crate or box to the sender thereof for further use as packing. Hay or straw which has been used for packing purposes, if not so used again or returned as herein mentioned, shall be destroyed."

◆ ◆ ◆

At the annual gathering of the St. Helens staff of the United Glass Bottle Manufacturers, Ltd., the chairman, Col. Hopgood, was very optimistic as to the future both as to the improvement in trade and the position of the company. He stated that they (the U.G.B.M.) had succeeded in capturing most of the present markets for bottles and containers and would soon be in the position of dominating the glass bottle market. This will doubtless be interesting news to other manufacturers in this country.

◆ ◆ ◆

As was mentioned in a recent message from Moscow, three engineers are now making a tour of the various countries with a view to deciding upon the best equipment for the manufacture of refractory materials at the works in the Voronezh region.

◆ ◆ ◆

A prospectus has been issued by the Education Committee of the Pottery and Glass Trades' Benevolent Institution giving the general regulations for intending students in connection with the reading and correspondence course of technical education, conducted by the Committee for the benefit of salespeople in the pottery and glass trade.

◆ ◆ ◆

The shareholders of Messrs. Henry Hope & Sons, Ltd., Birmingham, the well-known manufacturers of patent roof glazing, steel casements etc., are being invited to subscribe for 50,000 new preference and 50,000 ordinary shares, of a nominal value of £1 each. The preference shares are offered at par and the ordinary shares at 30s. each, in the proportion of one new share for each two now held. The present capital of the Company is £300,000 and the proceeds of the new issue are to be used to acquire a similar business in the United States.

◆ ◆ ◆

Sir William Joynson-Hicks announced on February 3rd that as the Factories Bill would impose further burdens upon industry, the measure would not be proceeded with at present.

◆ ◆ ◆

Commenting upon the re-organisation scheme put forward by the directors of the British Glass Industries Ltd. (see page 114) the *Statist* says:—

" The subsidiary—the Canning Town Glass Works—paid no dividend, and it is not clear whether it earned even the interest on the first debentures. It is accordingly very difficult to say whether under the new scheme dividends will be sufficient to justify the present market quotation of 8¾d. for the 5s. shares of the holding Company."

◆ ◆ ◆

Almost everybody realises the commercial value of a " Good Trade Mark," but comparatively few appear to be acquainted with what can or cannot be used or the necessary procedure to obtain official registration.

We have just received from King's Patent Agency, Ltd., 146a, Queen Victoria Street, London, E.C.4, a 12 page booklet, containing some interesting facts on this subject which are taken from a paper read by Mr. B. T. King before the Publicity Club of London. Readers may obtain copies on application to the address given above.

◆ ◆ ◆

The Leipzig Spring Fair will be held this year from February 28 to March 6. In addition to the General Sample Fair embracing all the lighter trades, including glassware, there are numerous special Trade Exhibitions, covering almost every industry.

◆ ◆ ◆

In 1924 the production of machine-made window glass in Belgium showed a 50 per cent. increase over the output for 1923, the actual figures being 117,300,000 square feet, and 52,120,000 square feet respectively.

◆ ◆ ◆

According to the reports of the Prussian Chambers of Commerce, the German table-glass factories are making for stock, Czecho-Slovakian competition being so keen.

◆ ◆ ◆

In Silesia the table-glass works have combined for the protection of their mutual commercial interests.

◆ ◆ ◆

At the annual exhibition of glassware, held in Pittsburgh, during January, the Federal Glass Company were showing an all machine-made goblet. The machine makes the bowl, the stem and the foot and turns out the finished article without any manual assistance.

◆ ◆ ◆

The U.S.A. imports of glass and glassware for November, 1925, showed an increase of $163,685 over November, 1924. The greatest increase was in cut and decorated ware.

NOTICE.

DEFECTS IN GLASS

BY

DR. C. J. PEDDLE, M.B.E., F.I.C.

In response to numerous requests we propose publishing in book form this series of articles They are being entirely re-written with additional illustrations, and the book will be published at a popular price shortly.

GLASS PUBLICATIONS LTD.,
TALBOT HOUSE,
ARUNDEL STREET, STRAND,
LONDON, W.C.2.

New DEVELOPMENTS in GLASS FURNACES:

TEISEN New Wasp-Shape continuous Tank Recuperative Type

with longitudinal travel of flame. The most up-to-date Machine Tank, possessing Stream line features and securing:

HIGH EFFICIENCY
LONG LIFE
CONSTANCY OF TEMPERATURE
EASY MEANS OF REGULATION
GOOD ACCESS TO REPAIR TO THE THROAT

TEISEN New T Shape Cross Flame Tank Regenerative Type

For the largest capacities securing:

HIGH OUTPUT WITH ECONOMY OF FUEL

by better utilisation of the flame. Designed on the principle of the Modern Open Hearth Furnace.

LET ME STUDY YOUR PROBLEMS.

Individual Attention to all Furnace Matters.

Write Now—

Th. TEISEN, C. E.
Furnace Engineer,
20a, Temple Street,
BIRMINGHAM.
'Phone—Central 1806. *Cables*—TETE, BIRMINGHAM

SILLIMANITE

a neutral refractory material having a definite melting temperature above 3270°F (1800°C).

The December issue of GLASS reported the following expert opinions expressed in papers or discussion at the Leeds Meeting of the SOCIETY OF GLASS TECHNOLOGY:—

Mr. H. H. Houldsworth (of the Fuel Department, Leeds University).

"Experiments made on commercial sillimanite bricks showed that they exhibit very little permanent change in dimensions on heating, their refractoriness is high, and they offer great resistance to attack by soda-lime-silica glass."

Mr. F. G. Clark (of Messrs. Beatson, Clark & Co., Ltd., Sheffield).

"I can testify to the particular resistance to attack of a mixture of about 66⅔ per cent. sillimanite, from experimental data obtained at my works."

Professor W. E. S. Turner (of the Department of Glass Technology, Sheffield University).

"Glass manufacturers seemed to be more keenly interested in the resistance offered to corrosion by glass, by a refractory material, than its ability to withstand unusually high temperatures."

Mr. W. J. Rees (of the Refractories Department, Sheffield University).

"Sillimanite mixtures containing not less than 60% sillimanite were already justifying themselves for purposes where a highly refractory, resistant material was necessary."

P.B. Sillimanite is now available in the raw state, crushed and graded, and in the form of Bricks, Blocks, Shapes, etc.

The P.B. SILLIMANITE
COMPANY, LIMITED,

Sole Agents: PAWLE AND BRELICK.

791, SALISBURY HOUSE,
LONDON WALL, LONDON, E.C.2.

Telephone Number - London Wall 4825.

The Corrosion of Glass Surfaces.[*]

By GEORGE W. MOREY.[†]

Introduction.

" To the power of resisting the corrosive action of atmospheric agencies and aqueous solutions possessed by glass may be ascribed the extensive use of glass as a container, and in its other uses this property is also essential. The necessity of producing a glass resistant to corrosion definitely limits the compositions which may be employed, and makes impracticable some otherwise desirable glasses. The mechanism of the corrosion of glass by water is complex, involving in its initial stages a probable miscibility of glass, regarded as an undercooled liquid, with water, and in its later stages the complete decomposition of the silicates. At ordinary temperatures these processes require a long time for their completion, but at higher temperatures they can be followed in their various stages to the end. In interpreting the results obtained by the various methods of testing glass, it is necessary to bear in mind that the term " solubility " has no meaning in connection with such complex processes, and the testing methods employed merely afford a measure of the rate at which the reactions take place. Such rates of reaction are peculiarly susceptible to change in the conditions of experiment, and great care must be taken to specify these conditions. The effect of various oxides on the resistance of glass to corrosion is briefly outlined."

The resistance offered by glass surfaces to the corroding action of atmospheric agencies and aqueous solutions is a property of great practical significance. In a large proportion of the many uses to which glass is put, its power of resisting attack is the chief reason for its preferment over competing materials; in the other uses a high degree of chemical stability is an essential requirement. Glass containers are used for the distribution of commodities ranging from milk to medicines and acids, and here the superiority of glass leaves it without a competitor. More exacting are the requirements of the manufacturing industry; and here, too, the choice of glass as a container is justified only by its resistance to surface attack under extreme conditions. Other uses of glass—for example, in windows and lens systems—do not impose such a drastic test, but even here there must be no appreciable amount of surface alteration.

That glass must offer great resistance to the common corroding agents is thus a requirement of first importance. Indeed, so essential is this property that Zschimmer makes it a part of his definition of a glass. From the manufacturer's standpoint, it operates to limit definitely the compositions that may be employed. Many glasses possessing desirable optical or mechanical qualities are impracticable because of their susceptibility to corrosion.

The study of the effect of various substances on glass has occupied the attention of many investigators, but in spite of the large amount of work that has been done the subject is still in an empirical state. Nor is this surprising. The problem is not the simple one of determining the solubility of various glasses in water or other agent, that many have supposed. On the contrary, we have here to deal with a complicated process, whose initial stage we do not understand, and whose later stages involve highly complex equilibria under conditions difficult to specify.

Miscibility of Water and Glass.

The early experiments of Schott[*] and of Forester[†] led to the conclusion that the first step in the attack on glass surfaces by water consists in an actual entering of the water into the body of the glass. This has been confirmed by many subsequent workers, and appears to be a highly probable hypothesis. It may even be argued that this of necessity takes place. Glass is commonly, and rightly, regarded as an undercooled liquid, a liquid several hundreds of degrees below its temperature of equilibrium with the stable crystalline phases. Water and glass constitute a liquid-liquid system, and is it not probable that these two liquids, instead of having no miscibility, or a very limited miscibility, are miscible in all proportions?

The question is not easy to answer conclusively. The molecular mobility in a glass must be limited indeed, and the rate of penetration by water at ordinary temperatures must be small. The process is greatly complicated by the fact that not only the original anhydrous glass but also the increasingly hydrated product obtained as the process of penetration continues is essentially unstable as regards the formation of crystalline substances. The formation of these more stable phases is greatly accelerated by the entry of water into the glass, and usually the surface of separation between hydrated glass and partially crystalline material is practically coincident with that between anhydrous and hydrous glass.

This is not always true, however. In experiments at higher temperatures the initial stage of formation of a highly hydrated glass without noticeable crystallization has frequently been observed. The well-known observations of Barus[‡] furnish an excellent example. He found that glass heated under pressure with water took up large quantities of the water; at 185° C., the glass swelled enormously, and became white and turbid, while at 210° C. solution took place rapidly, and a clear liquid was formed. Morey and Fenner, sudying the

---

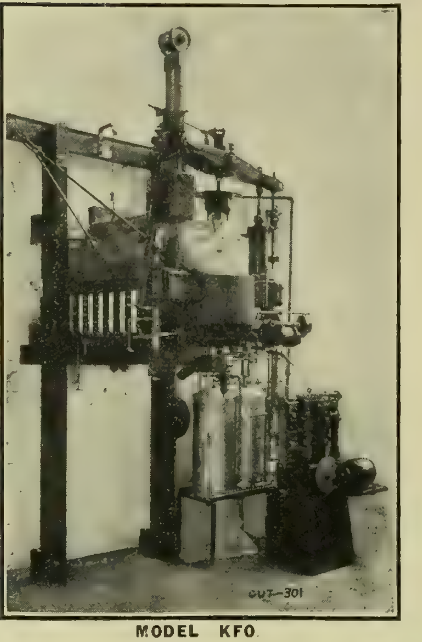
[*] Paper presented before the Division of Industrial and Engineering Chemistry at the 69th meeting of the American Chemical Society, April 6—11th, 1925.

[†] Geophysical Laboratory, Washington, D. C.

[*] Z. Instrumentenk., 9, 86 (1889).

[†] Ber., 26, 2915 (1893).

[‡] Am. J. Sci., [4] 9, 161 (1900).



MODEL KFO.

Latest Miller Feeder

PROGRESSIVELY DEVELOPED SINCE 1907.

By arrangement with **The Morgan Crucible Co., Ltd., Battersea,** a stock of all refractory parts for our feeders is now kept in London.

WILLIAM J. MILLER, Inc., SWISSVALE, PA., U.S.A.

London Office : **366, Strand, London, W.C.2.**

Tel. No.: Regent 5647.

Cables: Autoglasma, Rand, London.
Autoglasma, Pittsburg, Pa.

MOULDS

YOU ARE BOUND to improve the quality and output of your bottles and jars if you use **GOOD MOULDS.**

We supply moulds having the highest possible workmanship and finish. They are produced from the best crucible chilled castings and are machined throughout to precision gauges by practical mouldmakers.

Our service of quick deliveries and guaranteed accuracy in all respects is backed by **LONG PRACTICAL EXPERIENCE.**

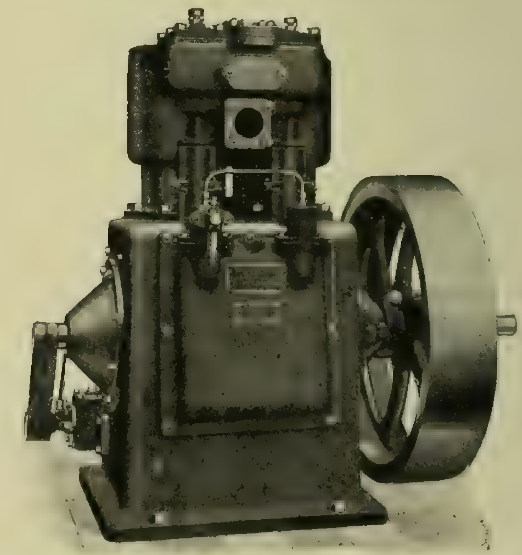
We specialise in mould equipment for **LYNCH, MILLER and O'NEILL** automatic machines but any and all types of moulds are undertaken

No Order too Large. No Order too Small.

We also supply Glassworks patterns and crucible iron castings of all descriptions.

JOHNSON RADLEY & SONS, Ltd.,
Chesney Works,
Hunslet, Leeds.

Telegrams—MOULDS, LEEDS
Telephone—LEEDS **21354.**



"BROOMWADE"

AIR COMPRESSORS

BRITISH AND BEST

FOR ALL DUTIES.

BROOM & WADE, Ltd., HIGH WYCOMBE.

equilibrium relations in the ternary system H_2O-K_2SiO_3-SiO_2 obtained glasses containing from 8 to 25 per cent. water, a continuous series ranging from hard, brittle glasses to viscous liquids resembling ordinary water glass. These glasses represented solutions unsaturated and therefore stable at the temperature of formation, but as unstable at ordinary temperatures as the usual glass. The natural glasses known as pitchstones, highly siliceous minerals containing up to 10 per cent. of water, may also be examples confirming the hypothesis of an actual miscibility between water and silicate glasses.

Instability of Glass.

It appears probable that, at high temperatures at least, water and silicate glasses are miscible to a considerable extent, but the substantiation of this at low temperatures is difficult. In addition to the slow penetration of the glass by water, there is the complication resulting from the essential instability of glass, an undercooled liquid only obtainable because of the characteristic reluctance of silicates to assume the crystalline condition. When water enters the silicate liquid, the tendency to form crystalline substances becomes greatly increased. This is especially true at higher temperatures. In an extensive study of the effect of water near its critical point (373° C. and 212 atmospheres pressure) on glasses, carried out in cooperation with his colleague, Dr. N. L. Bowen, the writer has been able to crystallize many glasses, obtaining from them numerous crystalline compounds, including many well-known minerals. For example, from a soda-lime glass are obtained excellent crystals of quartz and of wollastonite, the metasilicate of calcium. A similar process probably takes place at lower temperatures but too slowly for the final end products to be attained, at least in identifiable form.

Another consideration makes the low-temperature reaction more difficult to follow. At higher temperatures we have separation of minerals definitely in equilibrium with the solution, minerals possessing real "solubility" in the aqueous phase. At room temperature it is doubtful if any of these minerals, except quartz, possesses a true solubility. At low temperatures the process is almost exclusively one of decomposition, and there exists a fundamental distinction between the two cases, a distinction important not only for the understanding of the mechanism of the corrosion of glass surfaces, but also necessary to the interpretation of the results obtained in the testing of glasses for their power of resistance to such corrosion. In a system composed of water and a salt that is not decomposed by water, " solubility " of the salt at a given temperature has a definite meaning. Coexistence of three phases, solid, liquid and vapor, in a system of two components, water and salt, leaves but one degree of freedom, and the fixing of any one of the variables, pressure, temperature, or the composition of the solution, fixes the other two. This is not true, in general, in a system of more than two components. As an illustration, the ternary system H_2O-K_2SiO_3-SiO_2, which has been studied* from 180° to 1000° C., may be chosen. Figure 1 gives a number of isotherms in this system along each of which pressure changes continuously, but for the purposes of this discussion it is only necessary to state that the experiments were carried out in closed bombs, from which the water could not escape. The isotherms at 285° C. will be discussed first.

At this temperature potassium metasilicate, $K_2O.SiO_2$, has a true solubility in water, represented by the end point of the saturation curve on the H_2O-$K_2O.SiO_2$ side of the diagram. The actual solid phase at this temperature is not $K_2O.SiO_2$, but its monohydrate, $K_2O.SiO_2.H_2O$. As the proportion of SiO_2 in the liquid increases, the composition of the solutions in equilibrum with potassium metasilicate monohydrate follows the saturation curve of this compound until it is intersected by the saturation curve of a second compound, richer in SiO_2, potassium disilicate monohydrate, $K_2O.2SiO_2.H_2O$. From the fact that the tie-line H_2O-K_2O.-$2SiO_2$ cuts the saturation curve of $K_2O.2SiO_2.H_2O$ it follows that this compound also has a true solubility in water at 285° C. With a slightly greater proportion of SiO_2 the saturation curve of $K_2O.2SiO_2.H_2O$ cuts the saturation curve of a still more siliceous compound, $K_2O.4SiO_2.H_2O$.

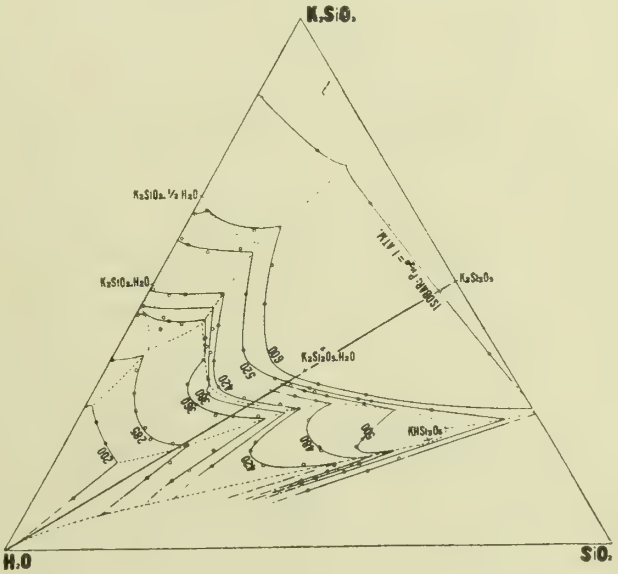


Fig. 1.

At 200° C. conditions have become very different, since, although the metasilicate monohydrate is still stable in contact with its liquid, the disilicate monohydrate is now decomposed by water. As the proportion of SiO_2 is increased, starting from the metasilicate side of the diagram, potassium metasilicate monohydrate remains the solid phase until its solubility curve is intersected by the solubility curve of potassium disilicate monohydrate, just as was the case at 285° C. But on further increase in the SiO_2 content, it is found that the disilicate no longer remains stable until the ratio SiO_2 :K_2O in the liquid becomes

(Continued on page 115.

---

* J. Am. Chem. Soc., 39, 1173 (1917).

British Glass Industries Ltd. Proposed New Company.

Presiding at the fifth ordinary general meeting of the British Glass Industries, Ltd., at Winchester House on January 22nd, Sir Rowland F. W. Hodge, Bt., in submitting the report and accounts to 31st October, 1925, said that they covered a period of twenty-two months. In the circular sent out on the 16th July it was stated that the company's ordinary shares in Glass Bottle Manufacturers, Ltd., had been disposed of by the bank. The satisfactory feature about the sale was that the liability to the bankers had been entirely extinguished. The company's principal remaining holding was in the Canning Town Glass Works, Ltd.; the other investments were not considered by the directors to be of much value. For these reasons the directors had stated in the report that, in their opinion, the investments now held could not be regarded as worth the figure of £747,000 at which they appeared in the balance sheet.

With regard to the Canning Town Glass Works, Ltd., the company now held the whole of the ordinary shares, the second debentures, and an interest in the first debentures. The par value of their holding was £530,000, but this figure was no criterion of the real value, for the reason that the company was not in a paying position. This was primarily the reason for the paragraph in the directors' report referring to the proposals for the reorganisation of the company's holdings. The principal reason why the company had not received any return on these holdings was that the prior charges were much too heavy, and therefore the scheme was twofold in its object. It sought to simplify the present complicated position, and so effect a reduction of the prior charges of the Canning Town Co., as well as enable that company to yield some return on the capital employed therein. This would necessarily involve a considerable sacrifice, at any rate in paper value, on the shares of the British Glass Industries. Up to now the Canning Town Co. had not met with the success anticipated, and early in its history it became apparent that it was vitally necessary to extend the range of products which could be manufactured at the works. He was told that a measure of success had now been attained, the benefit of which had yet to be felt.

Under the scheme it was proposed that a new company should be formed which would acquire from British Glass Industries, Ltd., and the Canning Town Glass Works, Ltd., the whole of their assets. The capital of this company would be approximately £400,000 all in ordinary shares of 9d. each. The new company would have approximately a sum of £70,000 liquid capital, provided in part by the realisation of the remaining assets of the British Glass Industries, Ltd., and the present liquid assets of the Canning Town Glass Works, Ltd. The present first debenture holders in the Canning Town Glass Works, Ltd., would be asked to agree to accept ordinary shares in this new company, in substitution for their debentures, and the existing second debentures owned by British Glass Industries would be cancelled. The effect of this would be that the new company would have no prior charges over the assets it acquired. The assets of the new company would be acquired at a figure which, the directors were told, would represent their present-day value. The par value of the new consolidated shares would be 9d. each, in order to permit of a share for share distribution to the shareholders of British Glass Industries, Ltd. The carrying out of the scheme would be subject to the fulfilment of certain promises made to the directors.

Capt. C. Bedworth, in seconding the adoption of the report and accounts, admitted that the scheme outlined was very drastic; but he thought it was the only thing to be done in the circumstances.

Mr. Northover asked whether the directors had considered the amount the shares would realise in the event of a liquidation. If the shares would only realise 9d. each in a liquidation, the company must certainly be in a very terrible position.

In the course of the meeting, the Chairman said that a meeting of the company would be called shortly, when the scheme he had outlined would be formally presented.

The report and accounts were adopted.

Telephone:
ROYAL
4208-9

Telegrams:
KAZMILANKO,
LONDON.

SAND

FOR GLASS MANUFACTURE.

FONTAINEBLEAU. BELGIAN. HOHENBOCKAER.

CAZALY MILLS & Co., Ltd.

beg to announce
that they are now able to offer regular supplies of guaranteed

FINEST QUALITY FONTAINEBLEAU,
HOHENBOCKAER & BELGIAN SANDS

as at present supplied to some of the leading Crystal Glass and Bottle Factories in the U. K.

HEAD OFFICE:
8-9 BYWARD St., LONDON, E.C.3.

BRANCHES:
Liverpool, Glasgow, Hull, Southampton.

The Corrosion of Glass Surfaces (*Continued from p.* 113.) the same as in the crystalline disilicate—namely, two. Instead, before that point is reached the saturation curve of the more siliceous compound $K_2O.4SiO_2.H_2O$ cuts the saturation curve of the disilicate, and with larger proportions of SiO_2 the disilicate is no longer stable. If water is added to a glass of the composition of potassium disilicate at 285° C. most of the glass will crystallize as potassium disilicate monohydrate, and the remainder will form a solution in which potash and silica are in the ratio of 1 : 2. If water is added to the same glass at 200° C., both the solid and liquid phases obtained will depend on the amount of water added. When a little water is added, enough K_2O will be extracted from the disilicate to form the more alkaline solution corresponding to the intersection of the two saturation curves; the remainder of the material will crystallize mainly as the hydrated disilicate, except that the excess of SiO_2 resulting from the extraction of some K_2O from the disilicate will form the more siliceous compound, $K_2O.4SiO_2.H_2O$. If more water is added more solution will be formed, more disilicate will be decomposed, and more $K_2O.4SiO_2.H_2O$ formed until at length all of the disilicate will have disappeared. Thus, by changing the amount of water we have changed the solid phase from one having a potash : silica ratio of a disilicate to one having the tetra-silicate ratio. The disilicate at this temperature is decomposed by water and can no longer be said to have a true solubility in water.

At a slightly lower temperature the metasilicate also is decomposed by water, and from the shape of the isotherms it appears probable that at room temperature all compounds of potash and silica are decomposed by water. True equilibrium at ordinary temperatures in any mixture, no matter how alkaline, would probably mean a solution containing a vanishingly small amount of silica, the actual amount depending on the amount of K_2O present, in equilibrium with a solid phase of pure quartz, or a crystalline compound of SiO_2 and water, if any such exists. To be sure, " water glasses " containing a large amount of silica, can be obtained but such solutions contain the silica in a colloidal condition, and bear no known relation to the true solutions which could co-exist with crystalline phases. For example, a potassium water glass can be obtained as a viscous liquid which would not be stable as a true solution below 450° to 500° C. The end result of treating potassium disilicate with water at the ordinary temperature, if the peptization of the SiO_2 could be prevented and true equilibrium attained, would be that practically all the SiO_2 would be left as quartz, and the liquid would consist of a potassium hydroxide solution containing a small amount of silica. But this solution would in no sense represent the solubility of potassium disilicate in water.

This system is analogous to those obtained with complex silicates such as glasses, ceramic bodies, and glazes, as well as natural minerals. When such substances are treated with water, either at ordinary temperatures or at such moderate temperatures as are obtainable in autoclaves, the compounds are decomposed, just as the potassium silicates are decomposed, and more or less of certain constituents passes into solution. In all these cases the end result, if equilibrium were attained, would be an alkaline liquid, containing small amounts of certain constituents and vanishingly small amounts of others, together with various crystalline phases, depending on the complexity of the original material. But this liquid would have no bearing on the solubility of the substance that had been decomposed, for the term " solubility " has no meaning in such a case. The original state of the material, whether crystalline or glassy, or a mixture of the two, will have no bearing on the end result of such a decomposition, although it will affect the rate of decomposition, and therefore the results observed in any experiment not carried to its ultimate conclusion.

(To be continued.)

We are informed by Mr. J. Kelaher, the European Representative of Wm. J. Miller Inc. that he has recently booked orders for seven of the latest type Miller feeders complete with electric timers and revolving plunger attachments, four of these being to the order of the United Glass Bottle Manufacturers Ltd., and three for the Co-operative Wholesale Society's factory at Manchester. All seven feeders are expected to arrive by the same ship, making a total of twelve feeders on order or being erected at the present time.

In connection with the success being achieved by the plunger rotating attachment as fitted to these feeders we might refer to an opinion we expressed in these columns (page 416, August, 1924), after seeing the drawings and before the first attachment had arrived in this country. At that time we stated that there was undoubtedly a large field for the device as a preventative of " stagnant metal " and an aid to a more homogeneous gob from the point of view of temperature.

The accuracy of this forecast has been proved by the number of feeders in Europe which have been equipped with it since August 1924. Mr. Kelaher tells us that he has sold almost 40 for operation with Miller feeders whilst he has also supplied the attachment for operation in conjunction with feeders of other makes.

◆

It is sometimes stated that glass forming machines have been developed to a greater extent than the feeding devices as the first named are able to make ware of differing shapes, heights etc. at the same time, but that all such ware must be of the same weight due to the limitations of the feeder.

Various attempts have been and are being made to overcome this, by providing cam attachments, etc. whereby a cyclic variation in the movement of the needle, etc. is given automatically. There still remains, however, the difficulty of varying the times allowed to the different phases of the " forming " cycle. This can be overcome by making each head or unit of the machine so that it is capable of being adjusted independently of the others.

THE OPTICAL SOCIETY.

At a meeting of The Optical Society held at the Imperial College of Science, South Kensington, on Thursday, 21st January, 1926—Mr. T. Smith, M.A., F.Inst.P., in the chair—the following papers were presented and discussed.

" The Interferometer Patterns due to the Primary Aberrations," by R. Kingslake, A.R.C.S., B.Sc.

In order to obtain a rapid estimate of the quality of a lens by observing its behaviour in the interferometer, it is necessary for the observer to be familiar with the characteristic patterns of the various primary aberrations under various conditions of adjustment. A method is described by which these patterns can be easily calculated for any required case; and series of typical patterns are shown together with actual interferograms for comparison.

" A Trichromatic Colorimeter Suitable for Standardisation Work," by J. Guild, A.R.C.Sc., F.Inst.P., F.R.A.S.

The paper describes a trichromatic colorimeter, which is suitable for standardisation work, as it may be employed to obtain the specification of any colour whatever in a form which may be converted if desired to any fundamental basis of specification. The three working primaries of the instrument are obtained by means of filters. The mixing of the primary colours is effected by a periscopic prism which rotates past three stationary sectors. Provision is made for adding any of the primaries to the colour under test, this may be necessary in order to obtain a match. In this way colours of higher saturation than it is possible to match directly may be dealt with.

" A Criticism of the Monochromatic-plus-White Method of Colorimetry," by J. Guild, A.R.C.Sc., F.Inst.P., F.R.A.S.

The author contends that, from the practical standpoint of quantitative colorimetry, hue and saturation are not the fundamental elements of colour quality but must be regarded merely as derivatives of the trichromatic constitution of the colour. Practical and theoretical reasons are advanced to show that whatever may be the advantage of specifying colour quality by hue and saturation there are grave objections to practical methods of colorimetry involving the direct measurement of saturation.

" On a New Method of Colorimetry," by J. Guild, A.R.C.Sc., F.Inst.P., F.R.A.S.

The paper describes a new method of determining the quality of a colour, as defined by its position on the trichromatic colour chart, in which only the colour-matching properties of the eye are involved. The determination depends on two colour-matches in each of which the test colour is matched by a mixture, in unknown proportions, of a standard colour and a monochromatic colour obtained spectroscopically, a different standard colour being used for the two matches. An instrument is described in which the method is embodied.

A demonstration was given of the " Trans-Lux " Daylight Picture Screen, by Messrs. The Gaumont Company, Ltd.

The screen is of a specially prepared material and is such that a picture projected on to one side of it can easily be seen on the other side, even when the room is fully illuminated by daylight or artificial light. Its use obviates the necessity of darkening a room in order to view projected lantern slides or kinema films.

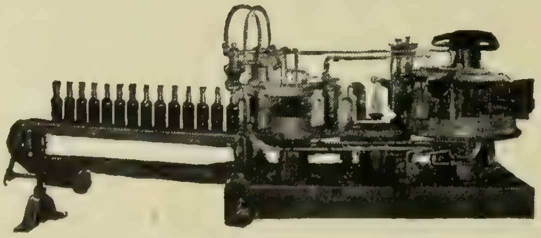
* * *

At the invitation of the Directors, the staff and workmen at the Hayes factory of the United Kingdom Glass Co., Ltd., were entertained to dinner on January 16th. About 200 were present; Sir Richard Garton, C.B.E. presided in the absence of Mr. C. A. Chidel, through illness.

After the loyal toast had been honoured presentations were made to the Directors by the men as marks of esteem and regard.

Responding to the toast of " The Directors," Sir Richard Garton mentioned his sympathetic attitude towards the working man and mentioned some of the difficulties the Company had experienced since its inauguration. He was looking forward, however, to a period of prosperity. New equipment was being installed and if the men and management would pull together, success was certain.

AUTOMATIC



May be Worked on Floor Level—No Pit Needed

NARROW NECK AND WIDE MOUTH
BOTTLE BLOWING MACHINE
No Transfer Boy. No Take-Out Boy.
STRICTLY AUTOMATIC
When Operated with Mechanical Feeding Device.
Can be Worked by Hand Gatherers. Speed 10 to
32 Bottles per minute, ranging in size from ¼ oz:
to Gallon
LYNCH GLASS MACHINERY COMPANY,
ANDERSON, INDIANA, U.S.A.
Cable Address—"LYNCHNOBOY" ANDERSON
Codes—A.B.C. 5th EDITION, BENTLEY'S, WESTERN UNION

British Glass Trade, 1925.

At the beginning of the year it was thought that there were indications of an improvement in the glass trade of this country but these indications were soon seen to be rather illusionary and the figures for the whole year show that although there was a slight increase in the value of our combined imports and exports as compared with 1924, yet it is the imports which have increased, our exports showing a slight fall, the actual figures being 5.7% increase in our nett imports and 3% decrease in our exports. In other words the merchants were more busy than the factories.

Class of Ware.	Value.			Quantity.		
	1923.	1924.	1925.	1923.	1924.	1925.
Scientific (excluding Tubing and Rod)	1.13	0.828	0.826	—	—	—
Tubing and Rod for all purposes	1.728	0.957	0.992	3.39	1.8	2.05
Illuminating Glassware	8.70	6.725	7.21	22.3	22.6	24.3
Machinery Glassware	0.034	0.056	0.09	0.027	0.084	0.077
Domestic and Fancy Glassware (including cooking utensils, table glassware, ornamental glassware) ...	5.72	5.2	5.1	20.5	17.5	17.8
Plate and Sheet Glass	0.947	0.984	1.08	1.15	1.2	1.4
Optical Glass (other than worked elements, e.g. lenses)	0.114	0.345	1.49	0.04	0.079	0.105
Bottles and Jars	2.74	2.36	2.59	4.05	3.85	4.0
Glass and Glassware not elsewhere specified	1.19	1.14	1.55	2.06	2.0	3.0

Table I.
Showing Ratio between Imports and Exports. Exports being taken as 1.00.

This, of course, has had its effect upon the ratio between net imports and exports, which is now almost 2 to 1. For the last three years the ratio is :—

	1923	1924	1925
Imports	1.817	1.795	1.95
Exports	1	1	1

These figures, of course, apply to the trade considered as a whole, as the ratios for the individual sections of the industry vary between fairly wide limits, i.e. from $\frac{.826}{1}$ for scientific glass to $\frac{7.21}{1}$ for illuminating glassware.

The following Table No. 1 has been prepared to show the relationship between our nett imports (i.e. after deducting re-exports), and our exports for the last three years. The relationship is given both for value and quantities or weights and in calculating the table the exports have been taken as 1.00.

Class of Ware.	Value in £ per cwt.					
	Imports.			Exports.		
	1923.	1924.	1925.	1923.	1924.	1925.
Tubing and Rod	3.65	3.9	3.32	7.12	7.28	6.8
Illuminating Glassware	2.95	2.73	2.76	7.54	8.88	9.04
Machinery Glassware	8.92	4.57	8.14	6.78	6.78	6.92
Domestic and Fancy	2.83	2.69	2.78	9.5	8.72	9.53
Plate and Sheet	1.77	1.67	1.45	2.16	2.02	1.87
Optical	43.9	65.8	77.5	28.3	23.9	28.4
Bottles and Jars *per gross*	0.76	0.65	0.64	1.16	1.07	0.99

Table II.

An examination of the figures in this table will emphasise several very noticeable facts. Firstly, that the ratio for the illuminating and domestic and fancy glass sections is very much higher than any of the others. (It is, of course, the manufacturers of glassware included in these two sections who have made application for a protective tariff to be imposed).

Secondly, that with the exception of plate and sheet glass, all those sections in which the values represent large amounts, we import more than we export, whilst even with plate and sheet the position has gradually got worse during the three years under review. Thirdly, and this is very noticeable, we find that the ratio as regards quantities or weights is much higher than it is for the values of the same class of ware. This can only mean one thing; namely, the price per unit quantity of the imported article is much lower than that of the British made article exported.

In order to make a proper comparison of these values Table II has been prepared. This shows the average value per hundredweight for the various categories (for bottles and jars the value is per gross).

From the figures in Table II it will be noticed that with two exceptions, machinery glassware and optical glass, the unit value of the British goods exported is much in excess of that of the imported article. The figures shown in Table III have been calculated from those in Table II and show the actual relationship between the value per hundredweight of the imported and exported ware (in the case of bottles and jars the unit is a gross). In each case the import value is taken as being 1, the table showing the comparative export value for the last three years.

Class of Ware.	Comparative Export Value, Import = 1.		
	1923.	1924.	1925.
Tubing and Rod ...	1.95	1.865	2.05
Illuminating Glass ...	2.56	3.25	3.28
Machinery Glass ...	0.76	1.48	0.85
Domestic and Fancy Glass	3.36	3.24	3.42
Plate and Sheet ...	1.22	1.21	1.29
Optical	0.65	0.36	0.37
Bottles and Jars (per gross)	1.54	1.65	1.54

Table III.

If we consider the four most important sections of the trade—by importance is meant the value in sterling of the business done and not the value from the technical point of view.—i.e. illuminating, domestic and fancy, plate and sheet, bottles and jars. Table I shows that of these the plate and sheet section is in the best position, as both in quantity and value the exports were only slightly inferior to the imports. It will be noted, however, that even here there has been a gradual loss of ground since 1923.

On referring to plate and sheet glass in Table III it will be found that of the four sections just mentioned this is the one in which the import and export unit values are the nearest to being equal. Bottles and jars is the section which is the next best situated (still taking the four chief sections only) according to Table I, and again, reference to Table III will show that the divergence in values is next least. The remaining two sections, illuminating and domestic and fancy, appear to be in anything but a reassuring condition, as indicated by imports having a total value 7.21 and 5.1 times the exports.

Table III would appear to indicate one of the reasons for this condition and also confirm the statements made in connection with the recent claims for Protection for these two sections, namely, that ware was being imported at prices much below the British manufacturers cost price.

ELECTRICALLY HEATED LEHRS.

According to the *Electrical World* the electrically heated lehrs as developed and installed in the San Francisco plant of the Illinois Pacific Glass Company, are proving entirely successful. Eight are already in operation and a ninth will be put into commission very shortly.

The lehrs are of the slat conveyor type and are 60 ft. long by 9 ft. wide. Each represents a connected load of 240 k.w. (320 h.p.) and an average 24 hour load of 80 k.w. (107 h.p.).

The temperature control is completely automatic the heating elements in the lehrs being divided into sections, each section having its own temperature regulating equipment. This system was adopted to give a closer control of the temperature curve throughout the length of the lehrs.

The average power consumption of the lehrs is 80 units (or k.w. hours) per hour and the following figures are taken from a test lasting three days. In each case the lehr is stated as being worked at about 75% of its capacity.

Type of Bottle.	Weight.	Number Annealed.	KW. hours per gross.
Export Beer ...	11½ oz.— 13½ oz.—	931 gross	7.09
Minerals ...	6½ oz.— 10 oz.—	1,048 gross	6.51

Two lehrs of this type have been installed recently at the Alton, Illinois plant for annealing five gallon water bottles.

◆

Czecho-Slovakia's glass exports to England in 1923 totalled 10,000,000 kronen, in 1925 15,000,000 kronen, while in 1926 it is estimated they will amount to 17,000,000 kronen.

December Trade Returns.

IMPORTS OF GLASS AND GLASSWARE.

		Quantities.				Value.			
		Month ended 31st Dec.		Year ended 31st Dec.		Month ended 31st Dec.		Year ended 31st Dec.	
		1924.	1925.	1924.	1925.	1924.	1925.	1924.	1925.
Scientific Glassware (except Tubing and Rod) ...	value	—	—	—	—	4,598	4,997	63,618	61,989
Glass Tubing and Rod for all purposes	cwts.	471	352	441	6,237	1,344	1,815	17,313	20,718
Illuminating Glassware	,,	17,999	15,965	150,913	156,029	49,954	47,079	409,885	430,405
Machinery Glassware	,,	6	41	377	332	109	256	1,723	2,708
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	59,503	64,964	572,945	617,305	157,111	190,065	1,540,941	1,716,597
Plate and Sheet Glass	,,	79,640	111,165	953,901	1,163,907	128,067	157,477	1,588,559	1,681,662
Optical Glass (other than worked Elements, *e.g.* Lenses)	,,	12	1	53	51	500	64	3,600	3,959
Bottles and Jars	gross	121,894	145,888	1,385,540	1,342,672	85,309	104,518	901,113	857,751
Glass and Glassware not elsewhere specified ...	cwts.	1,832	1,532	15,326	23,084	5,463	8,078	53,665	75,831
Total Value	£	—	—	—	—	432,455	513,349	4,580,417	4,851,620

EXPORTS OF GLASS AND GLASSWARE (BRITISH PRODUCTS).

		Quantities.				Value.			
		Month ended 31st Dec.		Year ended 31st Dec.		Month ended 31st Dec.		Year ended 31st Dec.	
		1924.	1925.	1924.	1925.	1924.	1925.	1924.	1925
Scientific Glassware (except Tubing and Rod) ...	value	—	—	—	—	4,615	7,583	70,529	67,460
Tubing and Rod for all purposes...	cwts.	268	132	2,465	3,043	1,261	1,026	17,972	20,693
Illuminating Glassware	,,	668	537	6,598	6,341	6,415	4,475	58,620	57,325
Machinery Glassware	,,	323	298	4.473	4,205	2,227	2,202	30,419	29,099
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	2,155	2,403	32,715	34,123	22,983	27,304	281,632	324,220
Plate and Sheet	,,	57,201	65,212	789,215	829,130	113,633	117,424	1,608,961	1,554,443
Optical (other than worked Elements, *e.g.* Lenses)	,,	8	2	394	86	605	97	9,429	2,445
Bottles and Jars	gross	21,282	23,668	350,077	328,009	22,881	21,865	374,574	322,006
Manufactures, not elsewhere specified	cwts.	642	632	7,465	7,480	3,692	4,075	44,399	46,404
Total Value	£	—	—	—	—	178,312	186,051	2,499,534	2,424,095

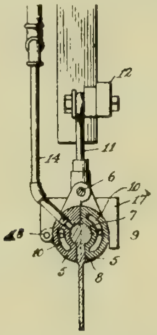
EXPORTS OF GLASS AND GLASSWARE (FOREIGN AND COLONIAL MERCHANDISE).

		Quantities.				Value.			
		Month ended 31st Dec.		Year ended 31st Dec.		Month ended 31st Dec.		Year ended 31st Dec.	
		1924.	1925.	1924.	1925.	1924.	1925.	1924.	1925.
Scientific Glassware (except Tubing and Rod) ...	value	—	—	—	—	364	475	5,059	6,312
Glass Tubing and Rod for all purposes... ...	cwts.	4	2	8	18	49	9	133	199
Illuminating Glassware	,,	108	277	1,834	2,230	856	2,495	13.322	17,212
Machinery Glassware	,,	—	6	—	7	—	49	—	78
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	761	749	9,193	9.740	3 779	5.212	59,229	62,123
Plate and Sheet	,,	121	160	6,652	3.134	207	247	7,276	3.985
Optical Glass (other than worked Elements, *e.g.* Lenses)	,,	2	—	22	42	20	—	325	312
Bottles and Jars	gross	350	3,065	17,762	30,152	390	1,379	14,567	24,567
Glass and Glassware not elsewhere specified ...	cwts.	39	34	392	624	277	183	3,045	3,700
Total Value	£	—	—	—	—	5,942	10,049	102,956	118,578

United States Patents.

GRANTED DECEMBER 29, 1925.

1,567,300.—**Glass Bait.** George G. Roberts, Washington, D.C., Assignor to The Virginia Plate Glass Corporation, Washington, D.C., a Corporation of Virginia. Filed May 11, 1923. Serial No. 638,294. 4 Claims. (Cl. 49—17.)



1. A bait for drawing glass in plate form consisting of a pair of separable sections pivoted together along their longitudinal edges and having a longitudinal slot between their lower meeting edges and an enlarged interior cavity extending the length of the slot, removable clamping means being employed to hold the sections together in closed relation.

1,567,445.—**Refractory Material, Articles made therefrom, and Method of Making the Same.** Simon J. Lubowsky, Jersey City, N. J., assignor to Metal and Thermit Corporation, Chrome, N.J., a Corporation of New Jersey. Filed Dec. 18, 1922. Serial No. 607,726. 8 Claims (Cl. 25—156.)

1. A material for use in making refractory, chemical resisting articles comprising calcined rutile with the particles in sintered union.

1,567,725.—**Leer-Feeding Apparatus.** Ira H. Freese, Clarksburg, W. Va., assignor to Hazel-Atlas Glass Co., Wheeling, W. Va., a Corporation of West Virginia. Filed November 17, 1923. Serial No. 675,273. 32 Claims. (Cl. 198——30.)

1. A leer feeder including means for lifting a row of glass ware, said means being operative irrespective of the number of articles or their lineal position in the row, and means for depositing the glass ware in the leer.

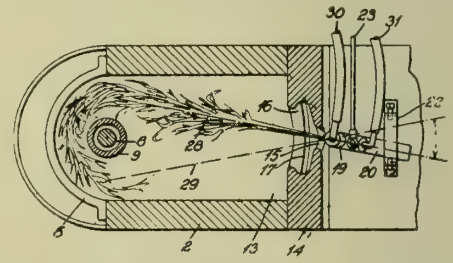
15. A leer feeder including a carriage movable bodily toward and from a leer, arms pivotally mounted on the carriage, gripping jaws carried by the arms, a fluid pressure cylinder operatively connected with the gripping jaws, and means for varying the limit of stroke of the piston in said cylinder to vary the extent of closing of the gripping jaws.

25. A leer feeder including a carriage movable bodily toward and from the leer, arms carried by the carriage, means carried by the arms for picking up glassware, and means carried by the arms for pushing glassware.

1,567,756. **Method and Apparatus for Flattening and Annealing Sheet Glass.** Louis R. Schmertz, Jeannette, Pa., assignor to Window Glass Machine Company, Pittsburgh, Pa., a Corporation of New Jersey. Filed August 5, 1924. Serial No. 730,204. 5 Claims. (Cl. 49—4.)

1. In the method of making flat sheet glass, the steps consisting in supplying unflattened glass to a flattening oven, flattening the glass therein, passing it from the oven through a leer to anneal and cool the glass, supplying heating gases to the flattening oven, passing heating gases from the flattening oven through the leer in streams above and below the glass so regulating the relative rate of flow of the gases above and below the glass as to equalise the rate of cooling from the two faces of the glass therein, and preheating the unflattened glass supplied to the flattening oven to compensate for the increased temperature of the surfaces contacting with the glass in the flattening oven induced by the regulation of the gaseous flow from the flattening oven through the leer.

1,568,021.—**Method and Apparatus for Heating Glass Feeders.** Everett O. Hiller, Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed March 14, 1925. Serial No. 15,511. 17 Claims. (Cl. 49—55.)



15. Apparatus for feeding molten glass, comprising a discharge chamber for the glass, having a downwardly opening outlet orifice, a vertical rigid member in said chamber for controlling the discharge of glass through said orifice, and a burner mounted to oscillate upon a pivot aligned with said orifice and with the said member, the said burner being arranged to project a laterally oscillating heating flame into said chamber, and to sweep said flame across said member during the oscillations of said burner.

GRANTED JANUARY 5, 1926.

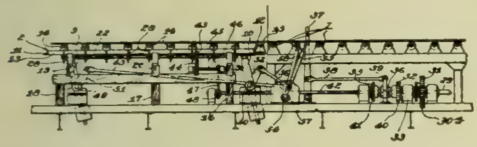
1,568,066.—**Lens Polisher.** Harry W. Hill, Southbridge, Mass., assignor to American Optical Company, Southbridge, Mass., a Voluntary Association of Massachusetts. Filed September 18, 1922. Serial No. 588,903. 1 Claim. (Cl. 51—279.)

A lens polisher comprising a fabric base having cross strands with voids between them, a wax covering the strands but not filling the voids, and a granulated abrasive covering the strands and filling in the voids, held in place by the wax on the strands.

GRANTED JANUARY 12, 1926.

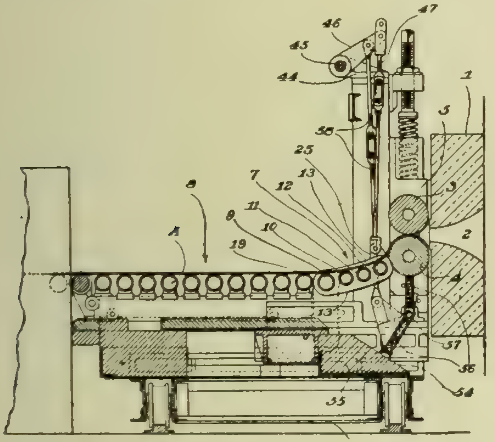
1,569,079.—**Apparatus for Cracking Off and Handling Continuously-Formed Sheet Glass.** Albert E. Evans, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed

March 18, 1925. Serial No. 16,423. 12 Claims. (Cl 49—48.)



1. Apparatus for cracking off and handling sections of a continuously formed horizontally moving glass ribbon, transversely scored to facilitate cracking off, comprising a table for receiving and supporting a glass section mounted for vertical movement so that it may be lowered below the level of the continuously formed ribbon causing the section upon the table to crack away from the ribbon and a secondary table below the level of the first table adapted to receive the cracked off section when the first table is lowered and provided with rolls mounted for rotation in planes at right angles to the line of movement of the ribbon.

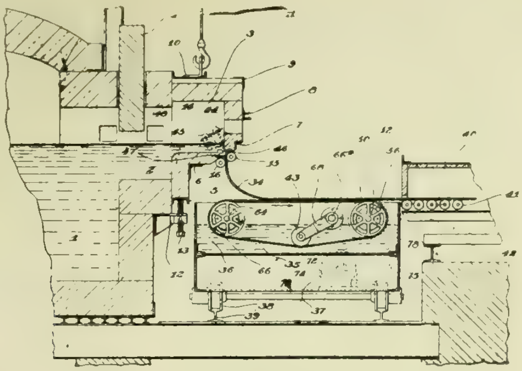
1,569,082.—**Apron for Plate Glass Machines.**—John H. Fox, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed January 22, 1924. Serial No. 687,704. 7 Claims. (Cl. 49—33.)



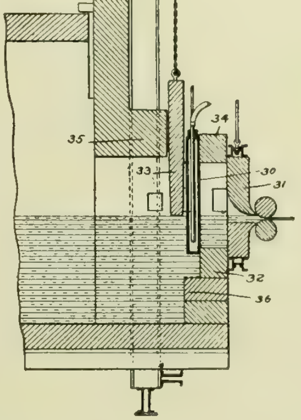
1. In combination with apparatus for continuously withdrawing a plastic sheet or ribbon of glass from a tank, including a pair of forming rolls, of a table for receiving the continuously formed sheet below the pass between the rolls, an apron intermediate the forming rolls and table mounted for swinging movement about its end adjacent the table, and means for supporting the apron at various angles of adjustment.

1,569,086.—**Apparatus for Making Sheet Glass.** Halbert K. Hitchcock, Pittsburgh, Pa., assignor of one-half to Hitchcock Experiment Company, a Corporation of New Jersey. Filed December 8, 1923. Serial No. 679,347. 12 Claims. (Cl 49—33.)

1. In apparatus for forming sheet glass, a glass container adapted to carry a bath of molten glass and having a downwardly directed outlet slot through which a continuous sheet or ribbon is adapted to discharge by gravity, a laterally extending endless belt of woven fabric in position to receive the ribbon, and a cooling bath through which the belt is passed.



1,569,134.—**Gate for Glass Tanks.** William Owen, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed December 8, 1923. Serial No. 679,343. 4 Claims. (Cl. 49—55.)



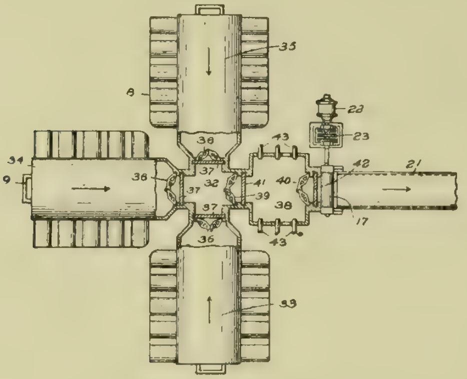
3. The combination with a melting tank having an outlet opening at its forward end, of a water cooled metal gate to the rear of such outlet opening mounted for vertical movement through the top of the tank, and adapted when lowered to cut off the flow of glass to said outlet, and a vertically movable shield of refractory material to the rear of the gate adapted to be lowered to a position with its lower edge adjacent to the surface of the glass bath or to be lowered into the glass and form an emergency cut off or gate.

1,569,652. **Glass-Body-Forming Machine.** Hans N. Halversen, Vineland, N.J., assignor to Kimble Glass Company, Chicago, Ill., a Corporation of Illinois. Filed February 2, 1922. Serial No. 533,574. 11 Claims. (Cl. 49—7.)

1. In a machine of the character described, the combination of means to heat a part only of a hollow glass body, and mechanical means to subject the interior of said body to a plurality of fluid pressures of progressively greater intensity to round out such heated part.

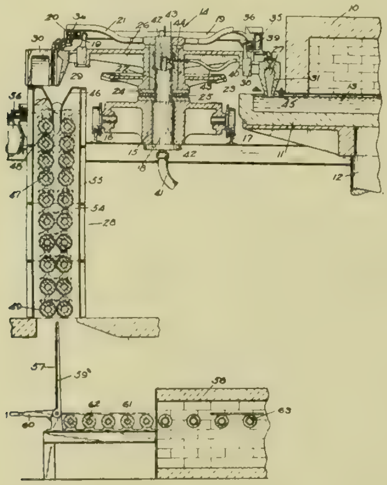
1,569,152. **Glass Tank Construction.** Thomas H. Swartzlander, Aspinwall, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania.

Filed March 25, 1922. Serial No. 546,860. 5 Claims. (Cl. 49—54.)



5. In combination in a glass tank construction, a receiving chamber having a plurality of laterally opening sides with a discharge outlet at one of said sides, a plurality of melting tanks leading into the other sides of the tank at angles to each other of less than 180 degrees, means for heating the melting tanks, and means for heating the receiving chamber.

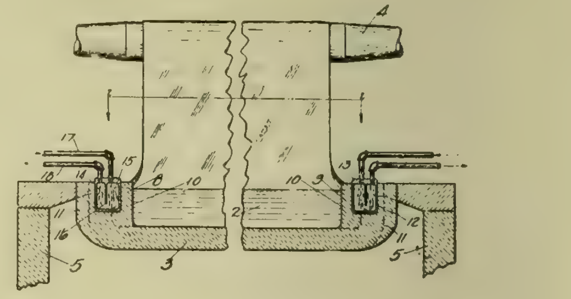
1,569,465. **Sheet-Glass Apparatus.** John L. Drake, Toledo, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed April 30, 1925. Serial No. 26,944. 18 Claims. (Cl. 49—3.)



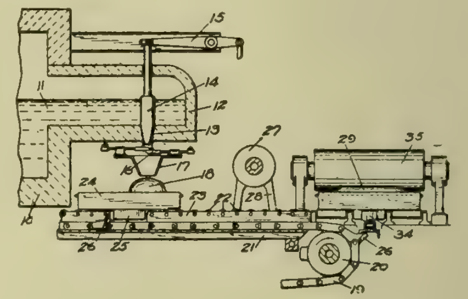
1. In sheet glass apparatus, a tank containing a mass of molten glass, means for picking up a charge of glass, and means for reducing the charge of glass through successive stages to sheet form.

1,569,471.—**Sheet-Glass-Drawing Apparatus.** Arthur E. Fowle, Toledo, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed December 18, 1920. Serial No. 431,534. 8 Claims. (Cl. 49—17.)

1. In an apparatus for producing sheet glass, wherein a sheet is drawn upward from a mass of molten glass, a pot containing the bath of molten glass, said pot having projections extending inwardly from the side walls adjacent the sources of the sheet edges, and cooling means within the pot walls and out of contact with the molten glass for maintaining the projections at a lower temperature than the other portions of the pot.



1,569,466.—**Sheet-Glass-Rolling Apparatus.** John L. Drake, Toledo, Ohio, assignor to the Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed April 30, 1925. Serial No. 26,945. 21 Claims. (Cl. 49—3.)



1. In sheet glass apparatus, a tank containing a mass of molten glass, means to discharge a gob of glass therefrom, and means to reduce the gob to sheet form by rolling it along different axes.

◆

Once more "flexible glass" has been discovered, on this occasion the credit being due to two Austrian scientists, Dr. Pollak and Dr. Ripper, but although the event has received wide publicity in the daily Press (making one somewhat suspect that a company flotation will not be long delayed), comparatively little authentic information is available.

It should be mentioned at once, however, that the name is very misleading as the new substance is not a glass at all (its only point of similarity being transparency), but is really in the nature of a hardened gelatine. It is obtained by the chemical reaction between formaldehyde and urea. Many remarkable claims have been made as to its superiority over real glass, but whilst not wishing to decry or belittle the scientific value of the inventors' work, we are not yet prepared to forecast the closing of existing glassworks. At the same time it is possible that it will be of value in connection with motor car windscreens etc.

BRITISH PATENTS.

The following abstracts are taken from the Illustrated Official Journal of Patents with the special permission of the Controller of H.M. Stationery Office.

Printed copies of the full specifications can be obtained from the Patent Office 25, Southampton Buildings, London, W.C. price 1/- each.

242,168.—**Glass manufacture.** Marks, E. C. R., 57, Lincoln's Inn Fields, London.—(Libbey-Owens Sheet Glass Co.; Toledo, Ohio, U.S.A.). April 8, 1925, No. 9410. (Class 56.)

FIG. 1

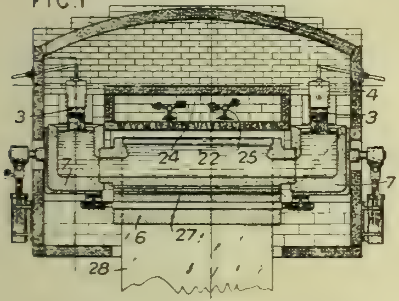
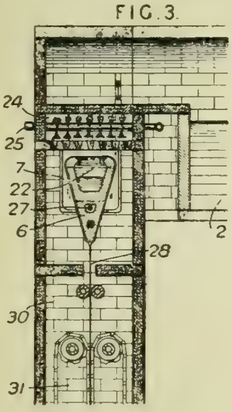


FIG. 3



Drawing.—A method of producing sheet glass consists in supplying molten glass continuously to a container so that it overflows at opposite sides in shallow even streams which flow together below the container to form a single sheet. The container, as shown in end elevation in Fig. 1, and in cross section in Fig 3, consists of a wedge-shaped body 6, of fireclay, formed with a trough 22, and two supply-pots 7 which may be formed in one with the body 6. The container is adjustably arranged at the end of a tank 2 from which it receives metal by two side conduits 3, the supply of metal being regulated by gates 4. The two streams of metal flow through the pots 7 into the trough 22, and the metal therein flows over the opposite edges and down the sides of the wedge 6 in two shallow even streams which unite below the wedge to form a sheet 28. The sheet is drawn away by suitable drawing apparatus 31 in an annealing chamber 30. The temperature of the metal is regulated by burners 25 in a heating-chamber 24, and by an electric heater 27 placed within the body of the wedge.

242,193.—**Glass manufacture.** Robson, W. H., 37, Cardigan Place, Albert Park, and Leggo, H. M., 218, Queen Street, Melbourne, both in Victoria, Australia. June 8, 1925, No. 14831. (Class 56.)

FIG. 1.

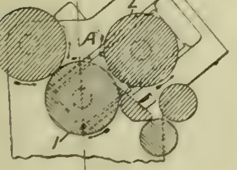
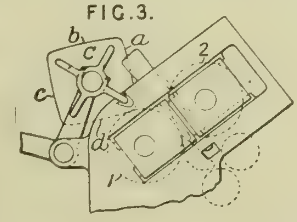


FIG. 3.



Rolling.—Relates to a double roller machine and consists in using another roller, or an adjustable member having a series of surfaces, to form with the primary rolls a recess or hopper to receive the molten glass and thus replace the "teeming plate" usually employed. The primary rolls consist of a lower pressing-roll 1, Fig. 1, and a companion pressing-roll 2 which is arranged somewhat above the roll 1. A third roll B is placed on the opposite side of the roll 1 and somewhat higher than the roll 2, the three rolls forming between them a space A which serves as a hopper for the reception of the molten metal. The roll B is rotated with the other rolls and is placed sufficiently close to the roll 1 to prevent the metal from escaping between them. In a modification, the roll B is replaced by a block C, Fig. 3, having a series of surfaces *a*, *b*, *c*, *d*, any one of which can be brought into position to form a wall of the hopper.

242,213.—**Glass Manufacture.** Glaswerke Ruhr Akt.-Ges., 1a, Beisingstrasse, Essen, Germany. December 15, 1924. No. 30152. Convention date, November 1. (Class 56.)

FIG. 3.

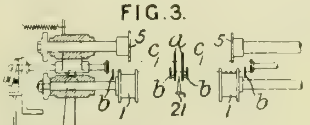
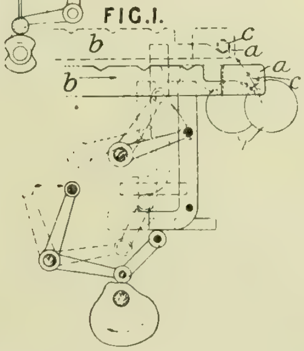


FIG. 1.



Relates to a machine of the kind described in Specification 177,884 for forming an open-ended tube into two tubes with closed ends, such as tablet tubes. According to the invention, the closed ends of the tubes are flattened by means which prevent them from being spread-out or deformed. The bottom ends of the tubes are flattened by means of plates *a*, Fig. 1, fixed to the inner sides of the bars *b* that lift the finished tubes away from the place at which they are formed, as described in the earlier Specification. A glass tube *c*, Figs. 1 and 3, rests on and is rotated by rollers 1 while it is being heated at the middle by a burner 21. After it has been heated sufficiently, the rollers 1 are separated to draw the ends of the tube apart and form two tubes having closed ends. When the separation is complete, the bars *b* are raised so that the plates *a* stand between the closed ends of the tubes; the rollers 1 are then moved inwards so that the ends of the tubes are pressed against the plates *a* and are flattened. The tubes are held in contact with the rollers 1 by means of discs 5 which are pressed against the tubes by springs. The pressure is adjusted to such an amount that when the tubes are brought up to the plates *a*, the rollers 1 will slide along the tube if the pressure of the tubes against the plates becomes excessive, thus preventing the flat bottoms formed on the tubes from being spread out.

242,574.—**Glass manufacture.** Soc. Anon. Ateliers J. Hanrez, Monceau-sur-Sambre, Belgium. August 28, 1925, No. 21634. Convention date, July 2[illegible]. Drawings to Specification. (Class 56.)

Drawing.—Relates to continuous sheet-drawing apparatus of the Fourcault type, or of the types in which the sheet is held in contact with the drawing-rolls by means of counterweighted rollers that yield to irregularities in the sheet. According to the invention, the counterweighted rollers are made hollow to reduce their weight and thus to reduce the risk of breaking the sheet through shocks caused by the movement of the rollers. It is stated that thin sheet can be produced by using these rollers.

242,859.—**Grinding sheet glass etc.** White, A. E., 88, Chancery Lane, London.—(Pittsburgh Plate Glass Co.; Frick Building, Pittsburgh, U.S.A.) March 21, 1925, No. 7701. (Class 60.)

FIG 1C

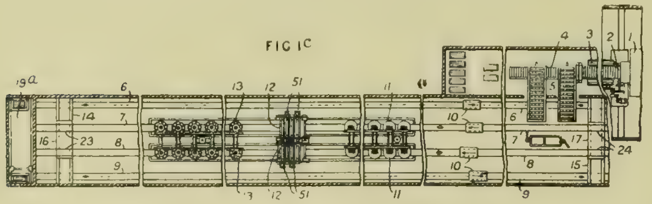
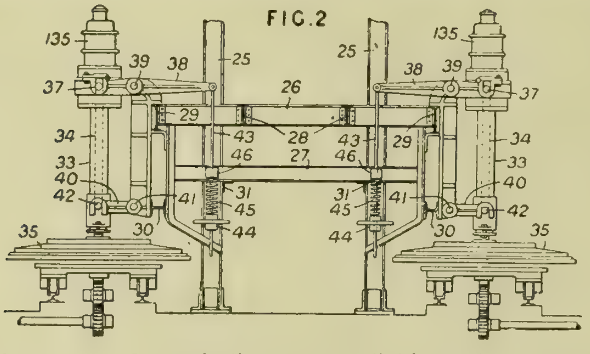


FIG. 2



Apparatus for grinding and polishing glass etc. of the type in which a series of tables carrying the glass pass successively under grinding and polishing runners from end to end of the apparatus comprises two parallel tracks for cars carrying the glass sheets, opposed series of grinding and polishing machines arranged above each track, a return track on each side of the parallel tracks, and transfer means between the four tracks at both ends. Glass issuing from the outlet 1 of a melting tank is formed into a continuous strip by rollers 2 and passed through an annealing leer 3 on to a table 4, where it is cut into sections, which are transferred by roller tables 5 to cars 10 on a track 7 running under series of grinding machines 11, brushes 12, and polishing machines 13, whereby the surfacing of one side of the sheets is completed. The cars 10 are then run on to one of a pair of tracks 23 on a transfer car 16 on a transverse track 14, transferred to a return track 6 parallel to the track 7, and run back past the starting point on to one of a pair of tracks 24 on another transfer car 17 on a transverse track 15. The sheets are now turned over on the cars, run along a track 8 under other series of grinding machines, brushes and polishing machines, whereby the surfacing of the other side of the sheets is completed. The finished sheets are lowered through an opening 19a, and the empty cars 10 are returned to the starting point under the roller tables 5 along another return track 9. The grinding etc. machines are carried on supports extending out laterally from a framework 25. . .31, Fig. 2, extending longitudinally between the tracks 7, 8. Each grinding machine comprises a casing 33 with driving motor 135, spindle 34, and runner 35, and is removably mounted in the framework by means of trunnions 37 mounted in fork levers 38 pivoted at 39 and held in vertical position by fork links 40 pivoted at 41 and engaging trunnions 42 on the casing 33. Pressure of the runners on the glass is adjusted by wheel nuts 44 on threaded rods 43 connected to the pivoted levers 38, springs 45 being interposed between the wheels 44 and brackets 46 on the framework. Each of the brushes 12 is driven by its own motor 51.

243,230.—**Glass manufacture.** Terrell, T., 118, Southwark Street, London. April 23, 1925, No. 10575. (Class 56.)

FIG.6.

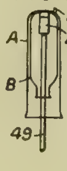


FIG.7.

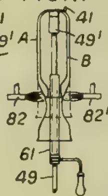


FIG.8.

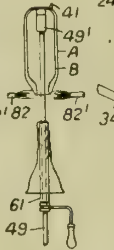


FIG.1

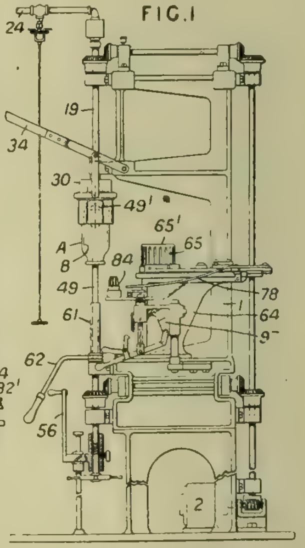


FIG.9.

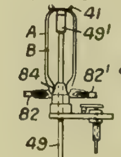
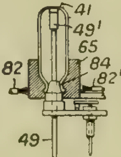


FIG.10.



Forming hollow-walled vessels.—A machine for making vacuum flasks comprises means for positioning an inverted outer blank concentrically above an inverted inner blank, means for raising the inner blank into spaced relation with the outer blank, means for fusing the edges of the blanks together, and means for shaping the neck of the flask formed by the fusion of the edges of the blanks.

Construction. The mechanism comprises two vertical shafts 19, 49, Fig. 1, which are journaled in bearings on a frame 1 and are rotated synchronously by a motor 2. The upper shaft 19, which is hollow, is connected at its upper end with a compressed air pipe 24, and at its lower end carries a chuck 30 which can be opened or closed by a lever 34. The lower shaft 49 is free to slide in its bearings and is lifted or lowered by a handle 56. A sleeve 61 slides on the shaft and is provided with a handle 62 by which it can be moved. A bracket 64, secured to the frame 1, supports a two-part mould 65 preferably made of graphite and provided with vent slots 65^1. The mould supports slide horizontally on the bracket and can be moved by a lever 78 to a position where the mould closes around the neck of the flask. A core 84, supported by a swinging bracket 97, can be moved below and raised into the neck of the flask. The core is made in two parts so that it can be caused to embrace the shaft 49. Gas burners are supported in such a position that their flames play on the neck of the flask.

Operation. The method of making a flask is shown diagrammatically in Figs. 6-10. An outer blank A, which has the exhausting nipple 41 formed, is placed in the chuck 30, and an inner blank B is placed over the shaft 49 so that it rests on a cushion 49^1 secured to the shaft. The shaft is now raised so that it lifts the inner blank into the outer one, and is locked in position. The blanks are rotated synchronously by the motor, and flames from burners 82, 82^1 are adjusted to play on the outer blank. The glass softens and contracts and is drawn out by the weight of the lower portion of the blank, the separation of the excess glass being assisted by movement of the sleeve 61. The contracted portion of the outer blank meets and adheres to the lower end of the inner blank thus forming the neck of the flask. The inner core 84 is then moved into the neck of the flask and the mould 65 is closed around the neck. Compressed air from the pipe 24, admitted to the chuck through the hollow shaft 19, passes through the nipple 41 on the flask into the space between the walls and forces the hot glass of the neck to take the shape of the mould. After removal of the mould and core, the neck is annealed by flames from the burners.

243,322.—**Glass manufacture.** Boucher, J. and Boucher, A., 4, Rue Lazare Carnot, Cognac, France. October 6, 1925, No. 24908. Convention date, November 22, 1924. Not yet accepted. Abridged as open to inspection under Section 91 of the Act. (Class 56.)

FIG.2.

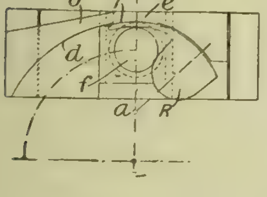
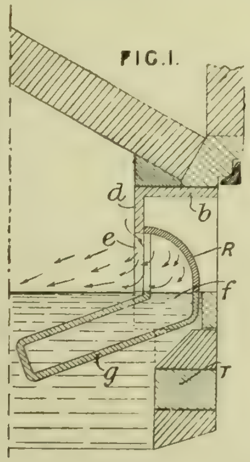


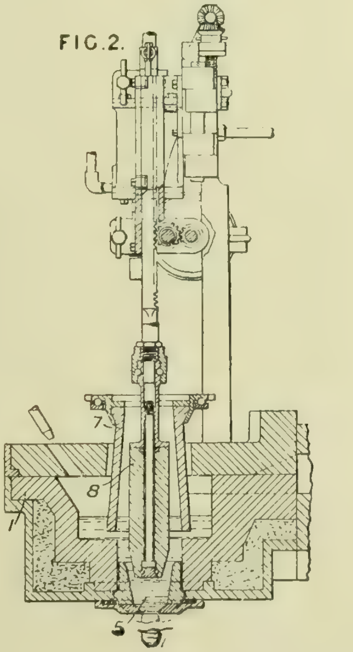
FIG.1.



Gathering molten metal.—A working-hole in a tank furnace, for use with a suction-gathering machine, comprises an opening through which the metal is gathered, and a shutter for uncovering and covering the gathering-opening, the shutter being adapted to admit hot gases to the surface of the metal at the gathering-opening during the time the opening is covered. The device is shown in sectional elevation in Fig. 1 and in plan in Fig. 2, and comprises a box-like member *b* of refractory material that is fitted in an aperture in the wall of the tank furnace T. The member *b* has an arc shaped wall *d* in which an opening *e* is formed, and a floor in which the gathering-opening *f* is formed, the openings being adjacent to one another, as shown. The opening *f* is fitted with a potette *g* or other device for segregating an area of metal. The shutter consists of a hood-like member R which fits over the two openings and has a wing *r* that conforms to the shape of the wall *d*. It is mounted on a suitable frame, which may rest on rollers, balls, or a race of some kind so that it can be swung about a centre *a* to uncover the opening *f* when a gather is to be made, and to cover it again when the gather is completed. When the opening *f* is uncovered by the hood R, the wing *r* covers the opening *e*. When the hood covers the opening *f*, hot gases from the furnace pass through the opening *e*, as shown in Fig. 1, and reheat the surface of the metal in the opening *f*. In both positions of the hood R, hot gases are prevented from escaping from the furnace.

243,459.—**Glass manufacture.** Rankin, C. H. 1233, Main Street, Wellsburg, West Virginia, U.S.A. September 3, 1924, No. 20761. (Class 56.)

FIG.2.



Delivering molten metal.—Relates to a glass-feeding apparatus of the kind comprising a discharge aperture 5 in the bottom of a cup 1 of conical or other shape, and a sleeve or tube 7, open at both ends, which dips into the cup and is adjustable vertically to or from the aperture. According to the invention, the sleeve is rotated or oscillated about its axis to stir the glass in the cup to secure uniformity of temperature in the glass surrounding the aperture. A plunger 8 reciprocates within the sleeve to control the formation of the charges of glass expelled from the aperture. In addition to the sleeve, either the plunger or the cup, but not both, may be rotated.

243,553.—**Joining Glass to Metal.**—Kirkland, J. W., Crown House, Aldwych, London.—(Allgemeine Elektricitäts-Ges. ; 2, Friedrich Karl-Ufer, Berlin.) January 2, 1925, No. 160. Drawings to Specification. [Classes 39 (ii), 56, and 99 (i).]

After fusing together glass and metal tubes or other articles, the contacting surfaces are brought respectively to different temperatures which depend upon the different coefficients of expansion of the two materials, and are such that in cooling down through the different ranges of temperature the linear contractions of the two surfaces are equal, thereby avoiding setting up stresses in the glass.

243,638.—**Glass manufacture.** Marks, E. C. R., 57, Lincoln's Inn Fields, London.—(Danner, E., 260, Hudson Avenue, Newark, Ohio, U.S.A.) June 30, 1925, No. 16830. (Class 56.)

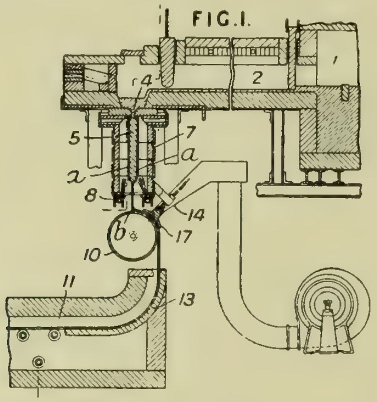


FIG. I.

Drawing; forming sheet glass with surface designs.—A method of forming figured glass consists in guiding a stream of glass on to an impression element provided with designs, and in forcing the plastic glass into contact with the impression element by means of gaseous pressure. The molten glass passes from a tank furnace 1 into a forehearth 2, where its temperature and condition is regulated, and from which it flows through an elongated slot 4. A vertical slab 5 is arranged below the slot 4, and the glass flows down the sides of this slab in two streams *a* which unite at the lower end to form a single sheet *b*. The slab is disposed within a chamber 7 heated by burners 8 which enable the temperature of the streams *a* to be regulated. The impression element consists of a roller 10 disposed below the slab 4, and the sheet *b* passes around the roller into a lehr 11. The roller is engraved on its surface with suitable designs, and the plastic sheet is forced into contact with the figured surface by means of a blast of air from a nozzle 14 having a flaring mouthpiece 17 which is disposed close to the sheet. The air blast also chills the outer surface of the sheet and prevents it from being marred by a curved surface 13 which deflects the sheet into the horizontal position as it enters the lehr.

243,880.—**Glass Manufacture.** United Glass Bottle Manufacturers, Ltd., Moorshead, T. C., and Riley, A., 40, Norfolk Street, Strand, London. November 1, 1924, No. 26099. (Class 56.)

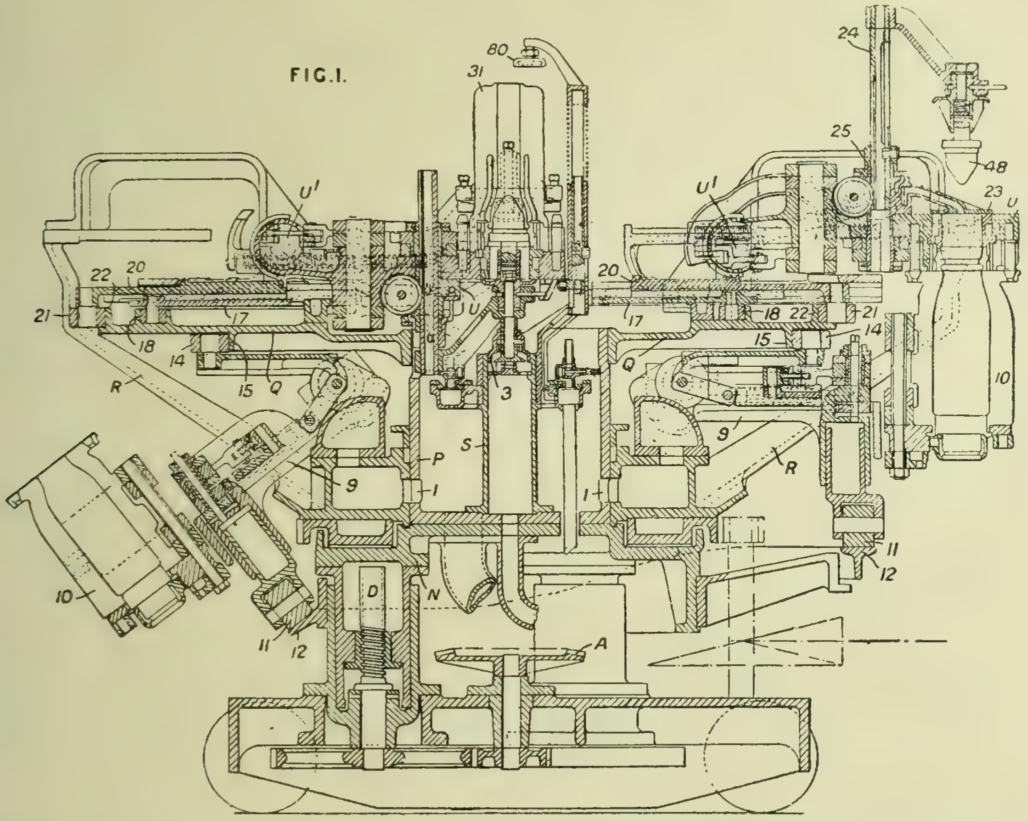
Blowing.—A machine for blowing glassware is enabled to rotate continuously, without the necessity for stopping and starting the moulds for a charging or gathering operation, by arranging the charging point for the glass at the centre of the machine. Each of the parison moulds is moved in turn to the centre of revolution to receive a charge of glass and is afterwards returned to a point at which it may register with a finishing mould.

Supporting the moulds. The parison moulds 31 are carried by a frame R which revolves about a hollow column P mounted on a carriage A. Screws D, which are geared to a common shaft, enable the frame of the machine to be raised or lowered to adjust the position of the moulds in relation to a feeder. A second column S is mounted within and coaxial with the column P, and at its upper end forms a connection with a valve 3 for sucking air from the parison moulds as they are brought in turn to the central charging position. The supports 9 for the finishing moulds 10 are pivoted to the revolving frame R and are provided with rollers 11 which run on a track 12 fixed to the base-ring N of the column P. The track 12 is shaped to raise and lower the moulds at appropriate times, the moulds being opened and closed, in the known manner, by a roll 14 which engages a track 15 on a fixed cam-ring Q.

Forming the parisons. The gathering-arms U, which carry the parison moulds, are journaled in bearings carried by the frame R, and the axles U^{1} of the arms are so arranged that the arms rotate, or turn over, in planes which are radial to the axis of the columns P, S. This turnover movement is obtained by slides 20 which are reciprocated by means of rolls 21 engaging a cam groove 22 in the fixed ring Q. Racks formed on the slides engage teeth formed on the axles U^{1} of the arms. The arms thus swing the moulds either to the gathering-position, in line with the axis of the machine, or to the edge of the frame R where they are in position to register with the finishing moulds. When an arm has swung to this position, the halves of the parison mould are swung back clear of the parison by means of a slide 17 operated by a cam roll 18. The finishing mould is then raised and closed on the parison. Blowing takes places with air supplied through a blowhead 23 which is pivoted on the arm and swings into close contact with the arm above the ring moulds. The arm also carries a plunger 48 for forming the mouth ring of the bottle and the initial opening in the parison. The plunger is carried by a rod 24 which slides within a sleeve 25 on the arm and is also turned through an angle. The combined movement lowers the plunger into the ring mould, and when raising it, swings it to one side. A cap, similarly mounted on the arm, closes the end of the mould while the charge of metal is being blown up to form the parison.

Operation. In use, the machine rotates continuously and the parison moulds are brought in turn to the central position to be charged with metal which may be directed into the mould by a funnel. The charge is packed down into the mould by suction applied through the column S, and also by compressed air applied by a blowhead 80 which is brought over and seated upon the open end of the mould. The blowhead is then removed, and the gathering arm is turned over to bring the mould to the transfer position. After the parison is blown up, the mould is opened and a finishing mould, which has risen into position, closes on the parison and the blowing is completed. Air for cooling the moulds and other parts of the machine is supplied through the column P which is provided with ports 1 that register at appropriate times with corresponding ports in the rotating frame R.

FIG. 1.



Latest British Patents.

Applications for Patents.

No. 32009.—December 31, 1925. T. C. Moorshead. Glass Furnaces.

No. 32252.—December 21, 1925 (Switzerland, December 21, 1924). Sibor Soc. Anon. Verreries de Romont. Manufacture of Glass.

No. 32275.—December 22, 1925. Kapella Ltd. (A. Warmisham). Lens Systems.

No. 32276.—December 22, 1925. Kapella Ltd. (A. Warmisham). Mounting of Lenses.

No. 32396.—December 23, 1925. R. L. Street. Refractory Linings for Furnaces.

No. 32466.—December 23, 1925. Morgan Construction Co. Regenerative Furnaces.

No. 32667.—December 28, 1925 (Germany, January 22nd, 1925. C. Zeiss (Firm of). Polishing Tools for Working Glass.

No. 32781.—December 29, 1925. R. F. Hislop. Heating Furnaces.

No. 32787.—December 29, 1925. G. H. Wingate. Manufacture of Lenses.

No. 32794.—December 29, 1925 (Czecho Slovakia, January 3, 1925). N. Starrach, E. Wesseley, F. Schneid. Drawing Glass.

No. 32795.—December 29, 1925 (Czecho Slovakia January 3, 1925). N. Starrach, E. Wesseley, F. Schneid. Drawing Glass.

No. 32808.—December 29, 1925 (Austria January 10). I. Kreidl. Production of white opacifying media for glasses and enamels.

No. 32850.—December 30, 1925. L. M. Wilson. Prismatic Lamp Glasses.

No. 32942.—December 31, 1925. J. L. Eden. Attachments to lenses of telescopes, etc.

No. 32952.—December 31, 1925. Dawson Bros., Ltd. Bottle Filling Machines.

No. 32974.—December 31, 1925. K. Koller. Distillation of Coal in Producers.

No. 32976.—December 31, 1925. M. Powley. Apparatus for transferring bottles, etc., to and from machines.

No. 32999.—December 31, 1925. D. M. Henshaw. Drying fuel gases.

No. 33017.—December 31, 1925. (Hungary, February 4, 1924). G. Szikla. Combustion, gasification, etc., of fuels.

No. 322.—January 5, 1926. G. E. Cooke. Glass Cleaning Apparatus.

No. 562.—Jan. 8, 1926. S. Dowthwaite. Drying clay goods.

No. 580.—January 8, 1926 (Germany, January 8, 1925). I. G. Farbenindustrie Akt. Ges. Production of potash glass.

No. 919.—January 12, 1926. (Denmark, July 31, 1925). A. Anders. Pindstofte's Maskinfabrik Aktieselskab. Bottle Machinery.

No. 1014.—January 13, 1926. Pilkington Bros., Ltd. (F. B. Waldron). Production of Polished Plate Glass.

No. 1015.—January 13, 1926. Pilkington Bros. Ltd. (F. B. Waldron). Production of Polished Plate Glass.

No. 1054.—January 14, 1926. F. S. Farnsworth. Ink Bottles.

No. 1183.—January 15, 1926. L. Rainchon. Gas Producing Furnace.

No. 1320.—January 16, 1926. J. E. Hackford. Generation of Combustible Gas.

No. 1589.—January 20, 1926. C. W. Beck. Manufacture of Glass.

No. 1591.—January 20, 1926. W. K. Couch. Grinding or Polishing Apparatus.

No. 1747.—January 21, 1926. Johnson and Johnson (Great Britain) Ltd. (Johnson and Johnson). Boxes for Tubes of Glass, etc.

No. 1766.—January 21, 1926. (Germany, January 23, 1925). Deutsche Gasgluhlicht Auer-Ges. Manufacture of refractory articles of pure oxide of zirconium.

No. 1833.—January 22, 1926. P. H. Prince. Glazing Glass.

No. 1916.—January 22, 1926. S. L. Bengston (Pfoser.). Method for heating Furnaces.

No. 2041. January 23, 1926. S. G. S. Dicker (Owens Bottle Co.). Glassware-forming Machines.

No. 2042.—January 23, 1926. S. G. S. Dicker (Owens Bottle Co.). Glassware-forming Machines.

No. 2043.—January 23, 1926. S. G. S. Dicker (Owens Bottle Co.). Glassware-forming Machines.

Specifications Published.

219972.—August 3, 1923. Janaer Glaswerk Schott. Gen. Glasses.

227848.—January 25, 1924. F. Nettel. Production of articles from Vitreous Slags and Glass Refuse.

234441.—May 23, 1924. Naamlooze Vennootschap Philips' Gloeilampen-Fabrieken. Device for Hermetically Sealing Electric Leading-in Wires in a Glass Wall.

236184.—June 24, 1924. L. Trefois. Automatic Charging Apparatus for Gas Generators and Other Furnaces.

241890.—October 21, 1924. Janaer Glaswerk Schott & Gen. Devices for Fusing Glass Extensions on to Glass Vessels.

242214.—October 30, 1924. Quartz Silice. Process for the Manufacture of Articles in Fused Silica, more especially intended for Electro-technical Uses.

242937.—November 13, 1924. General Electric Co., Ltd. Manufacture of Translucent or Coloured Bulbs, more especially for Electric Incandescent Lamps.

244849.—September 29, 1924. E. M. Long. Machines for Grinding and Polishing Lenses.

244975.—April 1, 1925. J. M. T. Johnson and J. E. Davies. Rotary Drum Apparatus for Drying, Heating, and Mixing Granular and other materials.

245297.—February 6, 1925. F. M. Oppermann. Grinding and Polishing of Glass Plates.

245313.—March 20, 1925. F. H. Rogers (Fuchs & Co., Dr.). Process for the Manufacture of a Flexible Wax-mass adapted to be Bronzed and Designed as Sealing-wax, for Sealing Bottles, and for Insulating and Impregnating.

245355.—June 15, 1925. W. J. Miller. Process and Apparatus for the control of the Feeding of Glass Fabricating Machines.

245362.—June 30, 1925. E. C. R. Marks (Danner, E.). Process and Apparatus for the Manufacture of Sheet Glass.

245561.—August 1, 1925. R. H. Kirkup, F. Kirkup and J. Thompson. Rotary Dryer for the Drying of Whinstone, Limestone, Sand, Clinker and such like material.

245655.—May 12, 1925. K. A. B. Ross. Bottle Filling and Stopper-applying Machine.

246051.—August 15, 1925. R. Cairns. Milk Bottle.

246057.—August 21, 1925. W. J. Tennant (Empire Machine Co.). Drawing and Flattening Sheet Glass.

Specifications Open to Public Inspection.—

No. 244749.—December 22, 1924. M. Fourment. Process and Apparatus for the treatment of Gases at high temperatures.

No. 245101.—December 24, 1924. Deutsche Gasgluhlicht-Auer-Ges. Process for the Manufacture of refractory substances from high-grade oxide of zirconium.

No. 245111.—December 19, 1924. A. Sandberg. Recuperative heat exchange Apparatus or air or toher media.

No. 245131.—December 21, 1924. Sibor S. A. Verreries de Romont. Manufacture of Glass.

No. 245449.—January 3, 1925. E. Wessely, N. Starrach and F. Schmied. Apparatus and Processes for Drawing Glass.

No. 245450.—January 3, 1925. E. Wessely, N. Starrach and F. Schmied. Apparatus and Processes for Drawing Glass.

No. 245751.—January 12, 1925. M. Stern and R. Ruhnau. Optical systems suitable for use in the projection of Moving Pictures.

No. 245757.—January 10, 1925. Dr. I. Kreidl. Process for the production of white opacifying media for Glasses and Enamels.

No. 245785.—January 8, 1925. I. G. Farbenindustrie Akt.-Ges. Process for the production of Potash Glass.

Prevailing Prices.

Arsenic (Continental or Japanese)	£16	0	0	ton
Arsenic (Refined white powdered)	£15	0	0	ton
Cobalt (Black Oxide)	*£0	8	0	lb.
Cobalt (Grey Oxide)	*£0	8	10	lb.
Cryolite (Synthetic) 99/100%	†£37	0	0	ton
Manganese Peroxide 85/87%	*£19	0	0	ton
Potash (Hydrated Carbonate) 83/85% ..	†£22	10	0	ton
Potassium Nitrate	*£24	0	0	ton
Red Lead, Finest English Manufacturing Glass Makers' quality	*£2	7	0	cwt.
Selenium (Black powdered) 99/100% ..	*£0	7	6	lb.
Soda Ash (Heavy)	£6	5	0	ton
Soda Ash (Light)	£5	17	6	ton
Sodium Nitrate (Refined Chilean) 96% ..	£13	7	6	ton
Sodium Nitrate (Synthetic) 96%	†£13	10	0	ton
Sodium Selenite	*£0	5	6	lb.
Sodium Silico Fluoride	*£17	0	0	ton

The above prices are for usual commercial quantities.

* d/d. Works.

† c.i.f. U.K. port.

Patents, Trade Marks, Inventions.—Advice, Handbook and Consultations free. King's Patent Agency Ltd., Director B. T. King, C.I.M.E., Regd. Patent Agent, G.B., U.S., and Canada, 146a, Queen Victoria Street, E.C.4, and 6, Quality Court (next Patent Office), London, W.C. 39 years' references. 'Phone: Cent. 682.

"Method of and Apparatus for Forming Sheet Glass." The Owners of British Patent No. 126747 desire to dispose of the same or would grant a licence to work the Invention on royalty terms. Particulars may be obtained from Technical Records, Limited, of 59-60, Lincoln's Inn Fields, London, W.C.2.

Kapella Limited, of Leicester, England, having acquired numerous patents (British and Foreign) on machinery and appliances for sawing and grinding glass, cutting discs, and mounting, grinding and polishing lenses, are prepared to pay the sum of £50 (fifty pounds) to anyone who may give them satisfactory evidence of any infringement of such patents. These patents are open to be licensed to responsible manufacturers.

Vitreous Enamel Colours.

Stains for Glass.

Oxides for Colouring Glass Metal.

Selenium Metal.

Selenate and Selenite of Soda.

GROUND BONE FELSPAR, FLINT, FLUORSPAR, QUARTZ, STONE, WHITING, ETC.,

CARBONATE & SULPHATE OF BARYTES

OXIDES OF ANTIMONY, ARSENIC, CHROME, COBALT, SMALTS, COPPER, IRON MANGANESE, NICKEL, TIN, TITANIUM, URANIUM, ZINC, ETC.

TRADE CERAMIC MARK

WENGERS, LTD.

CERAMIC COLOURS & CHEMICALS

ETRURIA.

STOKE-ON-TRENT.

England.

COLOURS FOR POTTERS, GLAZED BRICK MANUFACTURERS, & GLASSMAKERS.

Samples & Price Lists Sent on Demand.

PREPARED ENAMELS FOR CAST & SHEET IRON, COPPER & JEWELLERY.

Limespar.

Phosphate of Lime.

Nitrate of Soda.

Nitrate of Potash.

Opavetro for Opacifying Glass.

Alumina, Oxide and Hydrate.

GLASS
THE RECOGNIZED ORGAN OF THE GLASS INDUSTRY
Published on the Tenth of Each Month.

Single Copies - - - - One Shilling
Annual Subscription - - 10/6 post free

GLASS PUBLICATIONS Ltd.
TECHNICAL PUBLISHERS,
Talbot House,
Arundel Street,
Telephone: CENTRAL 5985. **Strand, London, W.C.2.**

CONTENTS.

	PAGE
Editorial Notes	131
Practical Notes on the Thermal Endurance of Glass.—By H. V. E. Renn	132
Coloured Glass and Glass Decoration.—By James H. Gardiner, F.Inst.P.	135
The Society of Glass Technology	141
The Optical Society	147
Trade Notes	149
The Use of Compressed Air.—By Robert Wilson ...	151
The Corrosion of Glass Surfaces.—By George W. Morey	155
The Source of the Coloured Glass used in Mediaeval Stained Glass Windows.—By John A. Knowles ...	157
Merchandise Marks and other Matters.—By Our City Correspondent	160
January Trade Returns	163
United States Patents	164
British Patents	167
Latest British Patents	171

Editorial Notes.

The subject of economy in the use of fuel is one which has been ventilated very frequently of late and although a certain amount of progress and improvement has undoubtedly been made in some instances, it will be universally admitted that in by far the largest percentage of works there still remains plenty of scope for further and material economies to be effected.

It is fairly safe to say that almost every manufacturing industry in the country is more or less dependent upon fuel of some kind, whether it be solid, liquid or gaseous, although the extent of this dependence varies between very wide limits. In some cases the fuel bill may represent only an infinitesimal percentage of the total production costs, but there are many others in which fuel may account for up to fifty per cent., in some instances possibly even more than this. In addition it will be found that those industries in which the fuel account bears the highest ratio to the total costs are the ones in which the actual fuel expenses in pounds sterling are also the highest, in other words they are the largest consumers. It follows, therefore, that they are the ones who should be most vitally interested in any means which will either reduce the price they have to pay per ton, or cubic foot, as the case may be, for their fuel, or enable them to employ it to better advantage and thus use less per unit of the goods they produce.

Amongst the industries so affected, the iron and steel trades will undoubtedly rank fairly high, but the glass industry will not be very far behind them and consequently we are pleased to be able to state that at last the subject is to be treated in the way that its importance calls for. Up to the present, although there may have been economies introduced in various industries, the knowledge of the methods and results have only circulated in the industry itself. It is also true to say that even this internal circulation has been somewhat limited, and as proof we may mention the case of the glass trade where we have some works producing a ton of bottles for the expenditure of approximately half a ton of coal and at the same time another works, making the same type of ware, using about twenty five hundredweights of coal per ton of bottles.

Each manufacturing process necessitates that its fuel problems be approached in a special way, but whilst recognising the truth of this and the fact that it is almost an impossibility to take a method which has proved beneficial in one industry and apply it *in toto* to another, we yet feel that it is often possible to obtain considerable benefit from modifications of such proved methods. This, of course, necessitates a closer co-operation between *all* fuel users and to enable this to be effectuated a meeting was held in London on March 5th at which was inaugurated an Institute of Fuel Technology. The object of the Instiution will be the study of fuel, its production and use, and all who are interested in the subject will be eligible for membership.

It is felt that the question is too large and important to be treated as an adjunct to any other organisation because if it received the attention it deserved, no time would be left for anything else. Furthermore, and in this we feel its chief value will lie, the new Institute will embrace *all* industries and will thus obtain automatically the co-operation and collaboration so much to be desired. A very influential Organising Committee was elected amongst whom may be mentioned Dr. M. W. Travers, who is a past president of the Society of Glass Technology.

Should any of our readers desire further particulars of this new organisation we shall be pleased to hear from them.

[GLASS *will deal with all matters pertaining to the industry in an impartial manner, consequently the Editor does not necessarily associate himself with the opinions expressed by his contributors.*]

Practical Notes on the Thermal Endurance of Glass.

By H. V. E. RENN.

The terms "liability to fracture" and "want of annealing" are often confused, and although well annealed glass-ware is by no means so fragile a substance as is generally imagined it is true that there is a liability to fracture even when there exists no visible sign of strain.

The liability to fracture in well annealed glass-ware depends upon several factors of which the most important are the expansion, thermal conductivity, tensile strength, elasticity and specific heat.

It was pointed out long ago that for every glass which is employed for manufacturing processes, all the properties mentioned above should be shown with precision, but the opinion still seems to exist among glassmakers that expansion, for example, has only to be considered in a few special cases. It is a well-known fact that in the making of cased glass, such as opal, ruby or green upon flint, or green upon opal, there should exist a difference in the coefficient of expansion of the component glasses, the inner glass having the smaller coefficient. This means that in cooling, the outer glass contracts more rapidly than the inner glass and has the effect of compressing its surface, in which condition it is more resistant to strain. In the making of lampblown apparatus, it is sometimes necessary to seal two different glasses together, and this operation can only be carried out successfully if the coefficients of expansion of the glasses concerned are comparative. Expansion is also of prime importance in the making of wired-glass, in which wire is embedded in the middle of sheet glass in order to strengthen it, for fracture may occur if there exists a large difference between the expansion of the metal and that of the glass.

Thermal expansion is not only a most important factor in such branches of glass manufacture as those already mentioned, but also in the making of practically every kind of glass, for in addition to a certain bearing upon the annealing problem, it concerns most particularly the property of thermal endurance.

Here again the fallacy exists in some quarters that the property of thermal endurance is a matter that only concerns the manufacturers of laboratory and heat-resisting glassware. The writer was vividly reminded of this misconception when, upon an occasion some years back, he visited an improvised warehouse of English and foreign table-glass. The glass, exposed to cold draughts, was cracking audibly on all sides. This was all the more striking since there were little signs of strain in the glass when it was examined under the polariscope.

The most important factor entering into the property of thermal endurance is the expansion that glass undergoes when it is heated. Let us consider the now familiar example of a hot liquid being poured into a cold vessel. The inner layers of the vessel immediately tend to expand due to the rise in temperature, but are prevented from doing so by the opposition of the outer layers. A state of compression is thereby set up in the inner layers and one of tension in the outer layers. Should the rise in temperature produce a tensile stress of sufficient magnitude, the outer layers will collapse resulting in the complete fracture of the vessel. It will be seen from this that one of the greatest factors entering into the question of thermal endurance is the expansion of the substance. The smaller the coefficient of expansion, the less the chance of fracture when the vessel is subjected to sudden changes of temperature.

The coefficient of expansion can be determined experimentally or, when only an approximate value is required, it can be calculated.

Experimental determinations are usually carried out either by the dilatometric method or by Fizeau's interference method. In the former case the weight thermometer is employed as when determining temperatures by weighing the amount of mercury contained. From a knowledge of the coefficient of apparent expansion of mercury the temperature can be determined, and conversely, if the weight of mercury contained in the glass vessel at two definite temperatures is known and also the coefficient of absolute expansion of mercury, it is possible to calculate the cubical expansion of glass.

The method finds its basis in the fact that the expansion of a hollow vessel is the same as if it were solid throughout. Since the expansion of each part of the material is in a fixed proportion independent of the other parts, the removal of the central portion is without effect upon the shell.

It is still a matter of controversy as to whether the material of the vessel can be regarded as isotropic. Callender says that it is rather gratuitous to assume that the expansion of a glass bulb is the same in all directions however carefully it may have been annealed.

It is first necessary to obtain a bulb of the glass under examination. One of about 25ml. capacity will be found suitable, having a neck bent twice at right angles and of narrow bore, in order to eliminate the possibility of error in adjusting the volume of mercury contained. Care should be taken that the test piece is well annealed, for it has been shown by several investigators that the presence of stress has the effect of increasing the expansion, the increase, of course, being more pronounced in such cases as thick glass rods that are comparatively difficult to anneal, than with thin-walled vessels.

The course of the experiment is as follows. The thermometer is first weighed empty and afterwards filled with mercury. The filling is a somewhat tedious procedure, and is usually accomplished by alternately heating and cooling the vessel while the open end dips into mercury contained in a small beaker. The filled thermometer is now allowed to attain a definite temperature (conveniently a few degrees above the prevailing room temperature) and afterwards weighed. It is now immersed in a water-bath maintained at about 80—90° C., and allowed to take up this temperature. Some experimenters prefer the second temperature to be that of boiling water. In most text books upon the subject of Physics, it will be found that the next step is to weigh the thermometer and contents, after having first allowed them to cool, and to determine the loss in weight due to expelled mercury. English and Turner, however, during their investigations on boric-oxide containing glasses, some of which were far from being durable, pointed out the liability of error arising from the action of water on the glass when the thermometer was immersed in the water-bath. They adopted the procedure of observing the quantity of mercury expelled, and used this as the basis of their calculations, and not the difference before and afterwards of the thermometer and contents. The mean value of the coefficient of cubical expansion between the temperature of the experiment can be calculated by means of the data obtained, which, for the sake of example, are assumed to be the following.

Weight of thermometer alone = 14.63 grms.
Weight of thermometer + mercury = 352.15 ,,
Weight of mercury alone = 337·52 ,,
Weight of mercury expelled = 3·59 ,,
Temperature at start = 15° C.
Temperature at finish = 83° C.

Let w_1 be the first weight observed and w_2 the calculated weight of the mercury left in the thermometer after heating, so that $w_1 - w_2$ = the weight of mercury expelled. Then the coefficient of cubical expansion is :

$$a(t_2 - t_1) - \frac{w_1 - w_2}{w_2(t_2 - t_1)},$$

where a is the coefficient of absolute expansion of mercury for the observed temperature range $t_2 - t_1$. Values for this have been carefully calculated by Sears, and represent the best that are known at present concerning the absolute expansion of mercury.

The values are given below.

0 — 30° C.	18,174 × 10—8
50° C.	18,194 ,,
75° C.	18,221 ,,
100° C.	18,251 ,,

In the above example the coefficient of cubical expansion of the glass is :

$$0.00018196 - \frac{3\cdot59}{333\cdot93 \times 68} = 0.0000239.$$

It may be mentioned here that the cubical expansion is three times the linear value, which is the increase in the length of a unit length produced by increasing the temperature 1° C.

In Fizeau's interference method it is necessary to obtain a plate of the glass to be examined from 1 to 10 mm. in thickness and having parallel faces. This plate is placed inside a quartz ring resting upon a flat quartz plate, while a second plate is placed upon the top of the ring. The under surface of this plate should be very close to the upper face of the glass specimen. A beam of light from a Geissler tube is allowed to fall upon the surface of the top plate. Part of the light is reflected at the upper surface, while the remainder passes into the space between the quartz plate and the glass specimen, and undergoes successive reflections between the two surfaces, part escaping upwards at each incidence upon the glass plate. As reflection will also occur at the under surface of the glass specimen, it is necessary to blacken it. The emerging light is examined through a telescope through which it first enters at right angles, being deviated down the tube by a right-angle prism, and again through a set of prisms before incidence upon the glass specimen. Interference between the emerging rays produces interference bands. The fringes formed in the focal plane of the objective would be circular if the surfaces upon which the reflections take place were perfectly parallel, but it is usual to incline the plate slightly so that the fringes then become more nearly straight lines. The space between the surface of the glass specimen and that of the quartz cover changes when the contrivance is heated owing to differential expansion, the resulting displacement of the fringes being determined. By this means very slight changes in thickness can be measured, and the method furnishes what is perhaps the most accurate means of determining the coefficient of expansion.

Schott investigated the dependence of the expansibility on the chemical composition, and came to the conclusion that it was possible to assign to each 1 per cent. of the oxides entering into the composition of the glass a definite proportion of the total coefficient of expansion. He accordingly arranged a set of coefficients by which the percentages of the constituent oxides must be multiplied, in order to obtain, by addition, the value of 10^7 times the coefficient of cubical expansion. The expansion of some thirty glasses were calculated and compared with results obtained experimentally, and in most cases a fairly close agreement was observed, the average difference, expressed as a percentage of the observed values, being approximately ± 3.

English and Turner, in their experiments upon the thermal expansion of soda-lime glasses concluded that in a series of glasses of generally similar type, the variation of the composition and the coefficient of expansion are related to one another in a simple additive manner. In testing Schott's coefficient values against their own observations however, they found that differences arose which led them to the conclusion that the values of Schott contained considerable errors. Experiments were commenced in order to arrive at a new set of factors, but so far as the writer is aware this important work has unfortunately not been completed.

Whereas Schott's values, as far as can be ascertained, were arrived at empirically, English and

Turner preferred to adopt some sounder basis for their calculations, and as a first assumption considered that the oxides in the fused amorphous condition take with them into the glass their own thermal expansion. The new factors for SiO_2, Na_2O, CaO and MgO led to closer agreement between observed and calculated expansions than had been obtained by Schott's factors, but with the attempt to calculate a new value for alumina, the method broke down, the value actually appearing negative. Also, in the boro-silicate glasses, the additive relationship that before seemed tenable was found not to hold good over a wide range. It is now well known that the reduction in the coefficient of expansion that is first of all produced in a glass by additional boric oxide ultimately reaches a minimum, and the expansion then increases. With glasses containing 20 per cent. Na_2O the minimum occurs with about 17 per cent. B_2O_3, while with 10 per cent. of the alkali, the minimum coincides with about 20 per cent. B_2O_3.

It would appear from this that the expansion factor for B_2O_3 given by Schott would prove useless when used to calculate the expansion of a glass with high B_2O_3 content, but such is not the case. With a glass (No. 42 in Winklemann and Schott's list of glasses) containing 56 per cent. B_2O_3, the observed and calculated expansions were almost identical. It must be pointed out, however, that the glass was of the lead-aluminium-borate type.

The writer has endeavoured to arrange a set of coefficients that embodies the work of Schott and that of English and Turner, and although he is aware that there are many experimental glasses, commercially valueless, for which the factors give somewhat poor results, he is of the opinion that they can be safely used when it is intended to gain only an approximate idea of the thermal expansion. The factors are given below

Na_2O	12.9	PbO	3.0
K_2O	12.0	ZnO	1.8
CaO	4.9	MgO	1.35
Al_2O_3	4.5	SiO_2	0.15
BaO	3.0	B_2O_3	0.1

The factors have been used to calculate the expansion of seven well-known commercial glasses, which, on account of their diverse composition, serve as a good test. The results are given with those obtained by using Schott's factors. The experimental determinations were carried out by the Bureau of Standards, Washington, the Fizeau-Pulfrich interference method being used and the temperature range 10° C. to 55° C. It will be seen that a closer agreement is obtained by using the new factors, the average error in using those of Schott being reduced approximately by half.

An example will be given in order to illustrate clearly the method of calculating the expansion of a glass by means of factors. If the analytical composition of the glass is not known it will first be necessary to determine the percentage of each oxide present. This can be carried out by means of the table given in a previous article by the present writer*. The percentage of each oxide is then multiplied by the corresponding coefficient factor, and the figures thus obtained give, by addition, the cubical expansion × 10^{-7}.

The following glass, No. 59 of Winklemann and Schott's list of glasses, furnishes a good example of a commercial soda-lime glass. The small amount of As_2O_5 present has been neglected in the calculation. The expansion of this glass was determined by three observers to be 290, whereas by means of Schott's factors, the value was 284.

Glass.	Percentage Composition.									Coefficient of Cubical Expansion × 10^7.		
	SiO_2	B_2O_3	ZnO	Na_2O	Al_2O_3	CaO	K_2O	MoO	PbO	A.	B.	C.
Pyrex	80.5	11.8		4.4	2.0	0.3	0.2	0.1		100	123	83
Jena	64.7	10.9	10.9	7.5	4.2	0.6	0.4	0.2		144	175	154
Fry	68.6	8.1	3.6	9.8	2.7	2.6	1.5	2.6		179	199	190
Kavalier	75.9			7.1	0.1	8.7	7.9	0.2		228	243	241
M.E.G. Co.	73.0	3.6	5.6	10.8	1.0	0.7	0.3	4.3		180	188	178
Nonsol	67.3	6.2	7.8	10.9	2.5	0.8	0.3	3.4		192	184	189
Libbey	75.9	10.8		8.2	2.1	0.4	0.7	0.1	1.0	152	165	141

A. Observed value.
B. Value calculated by using Schott's factors.
C. ,, ,, New ,,

---

* The Calculation of Glass Compositions, GLASS, March, 1925.

(*Continued on page* 139.)

Coloured Glass and Glass Decoration.

By JAMES H. GARDINER, F.Inst.P.

(Continued.)

Some very fine reds can be produced with copper; the effect, as in the case of gold, is probably due to the formation of ultra-microscopic particles of copper, although the writer has never succeeded in resolving them; possibly they are in the so-called amicroscopic state, that is, too small to be resolved even in the ultra-microscope.

In the case of copper, by slow cooling the metallic particles can assume such massive proportions as to become visible to the unaided eye, and there is produced that interesting glass artificial aventurine.

Before leaving the production of red or ruby glass mention must be made of the selenium rubies and reds that are largely used in the production of fancy lamp shades and cheap ornamental ware. As in the case of gold and copper, selenium red is brought out by after-heating, and some really good reds have been made with this metal, combined with cadmium, the writer has produced carmine or post-office red enamels, with this element.

The publication of formulæ is of very little real value, as the result obtained depends upon many things besides actual batch composition, so that in one case it may succeed while in another fail, but two special formulæ for selenium red glass of Stourbridge origin are here given:

No. I.

	lbs.	ozs.
Sand	100	0
Soda ash	62	0
Zinc oxide	15	0
Cryolite	4	0
Cadmium sulphide ...	1	4
Selenium met.	0	6

No. II.

	lbs.	ozs.
Sand	10	0
Soda ash	5	0
Cryolite	2	8
Zinc oxide	1	8
Cadmium sulphide... ...	0	1
Selenium	0	¾

The gold, copper, and selenium glasses with their distinctive tints and valuable properties are not only needed in the arts, but they are of very great use in photography, in the medical profession on account of their therapeutical effects in the treatment of skin diseases, in optics for the elimination of haze and rendering distant objects visible.

These latter applications call for a careful examination of the properties due to the different compositions, and for systematic methods of production, which will be discussed more fully later on.

The ruby reds that we have referred to are all cases of metallic suspensions, but in many, and indeed in most cases of colouration, we are dealing with true solutions although they can hardly be classed as chemical compounds.

Copper in a soda batch gives a beautiful peacock-blue, and fine greens can be produced in flint glass with both chromic and nickel salts.

As has already been pointed out, the most beautiful blues are the cobalts, but by the combination of nickel and cobalt in certain proportions a distinct neutral grey can be produced; this needs very careful balancing of composition and treatment, and in the resulting glass much depends upon the thickness of the sheet, a Ni-Co glass 2 mm. thick may give a pure grey, while the same glass in a plate 10 mm. thick transmits a port-wine red.

In addition to the well-known metallic oxides, the power for colour production by means of the rarer and less-known elements is very great. An instance of an unexpected colour effect is found in the case of Didymium; this for many years passed as an elementary substance, and in its first separation from its accompanying rare earths it forms a deep chocolate-coloured oxide, which, when added to a soda batch, gives a pleasing amber-coloured glass having valuable therapeutic and optical properties. In 1885 Auer von Welsbach showed that the so-called element didymium was in reality a case of the close association of two elementary substances, similar to the association of nickel with cobalt. These closely-allied elements have been separated, and named Neodymium and Praseodymium, respectively; the first gives to glass a deep rose-amethyst tint, and the second a very fine grass-green.

In these instances we are certainly dealing with solutions, and not suspensions.

The state of the metallic solution in glass gives rise to quite different colour. For instance, Iron in the ferric state gives a yellowish-brown, but in the ferrous state a deep sage-green; this glass was found by Sir William Crookes to have the very valuable property of absorbing infra-red radiation, and affords a valuable protective glass for those occupied in acetylene welding and similar industries. This glass, however, is not easy to produce.

Enough has been said to show that the production of coloured glass brings with it a great deal of interest and pleasure that is perhaps not found in other branches of the glass industry, if we except the artistic productions of Carl Keopping, Louis Tiffany, Harry Powell, and a few others.

It may be well at this stage to briefly review the question of coloured glass production. In the first place there is the purely artistic side, of which we have already given a few instances, and the pleasing objects that can be produced by judicious use of colour are numerous, but the subject needs care and discretion, or effects will be produced that are positively repulsive to a refined mind.

The need for the development of coloured glass production, however, assumes quite a different character when we realise the numerous and varied modern developments in the professions and industries that have made the need for the scientific production of coloured glasses.

In photography the commercial production of the panchromatic plate and the development of colour photography has created a need for coloured glasses of definite colour value. At present this industry, or rather, science, has to depend largely upon stained gelatine films, which are not ideal for the purpose. The recent great developments in the use of light as a therapeutic agent in the treatment of skin diseases calls for a glass that will transmit some radiations and absorb others. In ordinary medical devices, coloured glasses of standard tints for the examination of urine and other solutions; red glass is said to have been used for the windows of wards set apart for smallpox patients; special glass for protection against the harmful effects of X-rays and radium, glass that will transmit the chemically active ultra-violet radiations now extensively used in dentistry, and for many other applications in electro-therapeutics.

Botany calls for glass of specific light values, and much experimental work has been carried on to determine the best material for glazing the palm houses at Kew and other places.

Chemistry also demands special coloured glasses for storing many light sensitive products, and the recent great advances that have been made in ophthalmology, where special protective spactacle glasses have been found of very great value; spectacles with definite colour values are rapidly coming into general use even in our climate, while in India, Africa, Switzerland and other places, coloured spectacles are indispensable.

These instances, selected from many others, have convinced the writer that there is at the present time as great a need for scientifically attacking the problem of coloured glass production as there was in that of optical glass, when that work was taken up by Schott and Abbe at the Zeiss works in 1881, with a success that is now a matter of history.

At the present moment the coloured glass problem is in a transition stage. The average glass-maker has by past experience acquired the power of producing various coloured glasses by means of numerous more or less secret formulæ, but beyond the general colour, he has very little knowledge of the physical or optical properties of his productions.

The industries and professions, particularly the medical and ophthalmological professions, realise that remarkable and valuable effects can be obtained by the employment of various kinds of glass as light filters, but they cannot always say with certainty the actual kind of radiation they wish to employ. Thus development is hindered in both directions.

The obvious move is for the production of glasses with definitely stated colour values. The problem at first sight may look hopelessly complicated to the average glass-maker, but in reality with the instruments now at our command it is quite simple.

A few years ago the suggestion of using a polariscope in a glasshouse would have been regarded as absurd, but now there is hardly a factory working where the instrument is not in use. The employment of the spectroscope, the opacity-meter and the tintometer is only a further development. With these instruments the radiation values of any coloured glass can be recorded, and the information would be of great value in the industries and professions named, and would furnish the medical man and the ophthalmic surgeon with a means of ascertaining definitely the effect of the employment of specific radiations in the treatment of disease, and would greatly aid the real development of the science of radio-therapeutics.*

Much has already been done in the way of a beginning on the lines indicated, and the writer hopes that he may not be accused of personal reference, if he instances some cases of the systematic record of colour and radiation values of glasses with which he has been more or less connected.

Foremost in this work stands the researches of the late Sir William Crookes, O.M., F.R.S., upon the effect of adding various metallic oxides to the constituents of glass (see Phil. Trans. R. Society of London; series A, vol. xxi, pp. 1-25). This work, which extended over several years, has been overshadowed by the popular application of some of the glasses to the needs of the optician, with which at the moment we are not concerned, but in that research the metallic composition, absorption of heat-rays, absorption of ultra-violet light, transmission of white light and colour values were determined and recorded for some hundreds of glasses.

A few only of these formed the subject of the Royal Society paper referred to, and the others represent a volume of painstaking and costly research which at present remains an unknown factor outside the doors of the laboratory.

On the dissolution of Sir William Crookes's private laboratory the writer was able to secure the whole of the records of that research, and feels that the accompanying photograph may not be out of place as a record of unpublished work. It consists of some 200 and more carefully labelled specimens of coloured glasses that were made, and of which optically worked test-plates of two millimeters in thickness were examined for absorption of U.V. light, opacity and colour values, and transmission of infra-red radiation, and the results were methodically recorded.

---

* A real move in this direction has already been made by Messrs. Chance Bros. & Co., Smethwick, Birmingham, by the production of Contrast Filters of definite transmission values.

As long ago as 1904 figure values of the ultra-violet and X-ray transmissions of the then novel uviol glass produced by Messrs. Shott and Genossen, which were intended to show the valuable properties of the glasses in question. By colouring this glass deep blue, Messrs. S. & G. produced a glass by which the phosphoescent effects of ultra-violet light could be demonstrated.* The disastrous effects which followed the early employment of X-rays made it necessary to develop a means of efficient protection, and glasses used for this purpose can now be examined at the National Physical Laboratory, and the values are generally given in the equivalent thicknesses of metallic lead.

These subjects, although they may not seem at first sight to come under the heading of coloured glass, are in reality intimately connected with it, and together with true colour effects they call for the need of accurate measurement.

An instrument that is of the greatest value in the coloured glass industry, but which hitherto has not found much application in the glasshouse is the Lovibond Tintometer. This device consists in a great number of slips of glass of the primary colours with numerical values in each case, from the faintest to the deepest tints, with a carefully arranged method and arrangements for viewing them.

This instrument was used by the late Sir William Crookes in the work already referred to, and it was found to be of very great use, for with it the actual colour-value of any glass can be found and recorded numerically.

Such numerical records of the tint of glass that is being produced for any special purpose are of far more value than an opinion gained by looking through it without any reference to the light in which it is seen.

It may not be out of place to record an application of the tintometer in actual glasshouse practice.

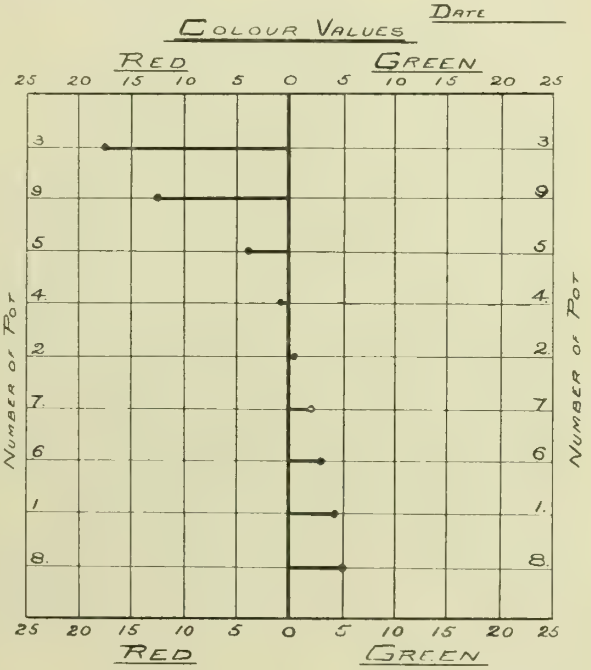
In a flint glass works where manganese di-oxide was used as a decolouriser there was the weekly problem of the " colour " of the metal. Too much manganese gave a warm unsatisfactory tint, and too little produced an unpleasant green or cold colour, also, on account of the effect of manganese changing with the time occupied in founding and working out the pot, there was always the tendency for the glass to be " warm " in the early part of the week and " cold " at the end; this made an accurate knowledge of the colour value of the metal in each pot on Monday morning desirable.

The following system was devised and put into operation.

First thing on Monday morning a test rod about half an inch in diameter and ten inches long was taken from each of the nine pots of metal in use (the ends of the rods as wetted off in the glass chair needed no further treatment).

These rods were examined " end on " by sending white light through them and comparing the colour with that of a similar rod of standard metal in the tintometer, the difference in tint between the two was equalised by adding green or red slips as was needed until the tint of the standard was the same as that of the rod under examination. These results were recorded on a chart similar to the one here reproduced and the value is obvious; for convenience the tests were recorded in the order of their colour values.

From the chart it can be seen that the metal in pots 3, 9 and 5 were slightly on the green side, as they needed varying amounts of red to bring them to the standard. Nos. 4 and 2 were as near perfect as could be, while 7, 6, 1 and 8 were slightly over-coloured and needed varying values of green to bring them down to standard.



Much practical information is given from this examination; pots 3 and 9 should be worked out at once, pots 5, 4, 2, 7 and 6 were as near perfect as could be, and should be worked in the early part of the week for " best work," while Nos. 1 and 8 can be left until the end of the week, by which time the slight pink tint will have burnt out and the metal should be up to standard.

It will be realised that we are here dealing with very faint tints only measurable in rods of glass ten inches long, but the tintometer enables one to deal with refinements of excellence that are generally left either to chance or to the skill of the mixer.

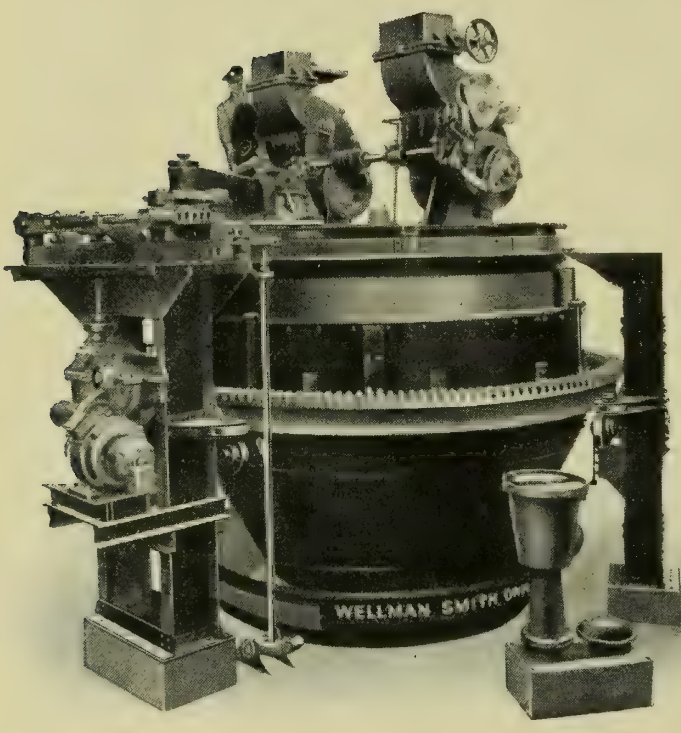
All this detail may look tedious and " scientific," but it is surely better to *know* the state of your metal than to let the workmen spend time on elaborate work only to find after it is finished and through the cutting shop that it is " off " or " over " colour.

Before leaving the subject of coloured glass, reference must be made to the irridescent glass that was produced in quantity some years ago. These very beautiful effects were produced by the action of chlorine gas on the surface of lead glass-ware; by applying this treatment to suitable articles some really beautiful effects can be produced. Unfortunately the indis-

---

* Journal, Röntgen Soc., Vol. 1, pp. 41-43.

WELLMAN AUTOMATIC GAS MACHINES



These machines are of particular interest to glass manufacturers since they yield a uniformly rich gas at a high rate of output.

This is chiefly due to the oscillating Poker device which loosens the fuel bed right in the incandescent zone where pastiness occurs.

No other device satisfactorily accomplishes this operation.

Other important features are described in our booklet which every Glass Works Manager and Engineer should send for.

No. 10 TO GASIFY UP TO 4,000-lbs. COAL PER HOUR.
No. 8 TO GASIFY UP TO 2,600-lbs. COAL PER HOUR.

THE WELLMAN SMITH OWEN ENG. CORP., LTD.

36-38, KINGSWAY, LONDON, W.C.2.
WORKS :: :: DARLASTON, S. STAFFS.

Telephones: HOLBORN 2588/9. *Telegrams:* "PRINCIPIUM, WESTCENT, LONDON."

criminate application to cheap ornamental articles killed the artistic possibilities of the process and it died an early death.

A somewhat similar effect can be produced by spraying the hot glass with hydrochloric acid before it passes to the lehr, and horrible productions are occasionally to be seen in the shop windows.

A valuable instance of the possibilities that follow a thorough examination of the colour value glass is shown in the following.

This simple examination gives a fund of valuable information; the best cathedral ruby is seen to be slightly tinged with blue, which probably accounts for its " rich " colour. It transmits mostly red, a total absence of green, but a faint trace of blue.

The copper ruby is almost equal to it, but there is no blue tinge, and in addition to red it transmits a little green light.

The selenium ruby also has no blue tint, and transmits red with orange, green, and a trace of blue.

Specimen.	*Tintometer Examination.*	*Spectroscopic Examination.*
Cathedral Gold Ruby. — Approved by the artist as equal to best ancient ruby.	Red ... ... 65.75 Blue 4.25	Transmit red and orange, no green, and a very faint transmission of blue up to 480$\mu\mu$.
Copper Ruby Pot Metal.—Colour almost equal to the gold specimen.	Red ... ... 41.5 Blue ... ... 0.	Transmits red, orange, and a little green, and a faint trace of blue.
Selenium Ruby. —Condemned by the artist as " carroty."	Red ... ... 41.0 Blue ... ... 0.	Transmits red, orange and green, with a trace of blue.
Gold Ruby. — Condemned as " bad colour."	Red ... ... 66.5 Grey 9.5	Transmits only red, without any trace of orange, green, yellow or blue.

The value of the red or ruby glasses in medicine and photography has already been referred to, and valuable information can easily be gained by the use of the tintometer and the spectroscope.

The three varieties of red or ruby glass in general use are produced by gold, copper, and selenium; each gives a glass that would naturally be called red glass, but the transmission of light and hence their actual properties are very different.

A sample plate ten mm. square and 2 mm. thick was taken of each of these glasses (there is no need for them to be flat or optically worked).

The poor or condemned ruby is interesting. The expert could not say what was wrong with it except that it was not " right "; the tintometer examination shows that the colour is red with a good percentage of neutral grey, which points to a reduction of lead or one of the other constituents of the batch; the spectroscope shows that the transmission is confined entirely to the red, and none of the rays of shorter wave length can pass through it. This would make the glass which was worthless to the artist of great value to the photographer, and its use would enable the medical man to be sure that the effects that he was getting or failing to get by its use were due to rays of definite value.

PRACTICAL NOTES ON THE THERMAL ENDURANCE OF GLASS.

(Continued from page 134.)

	Percentage Composition of Schott's Glass No. 59.		Expansion factor.	
SiO_2	73.2	×	0.15	10.98
Na_2O	18.5	×	12.9	238.65
CaO	8.0	×	4.9	39.20
As_2O_5	0.3	—	—	—
	100.00			288.83

The figure obtained represents the coefficient of cubical expansion $\times 10^{-7}$, the actual coefficient being 0.0000289.

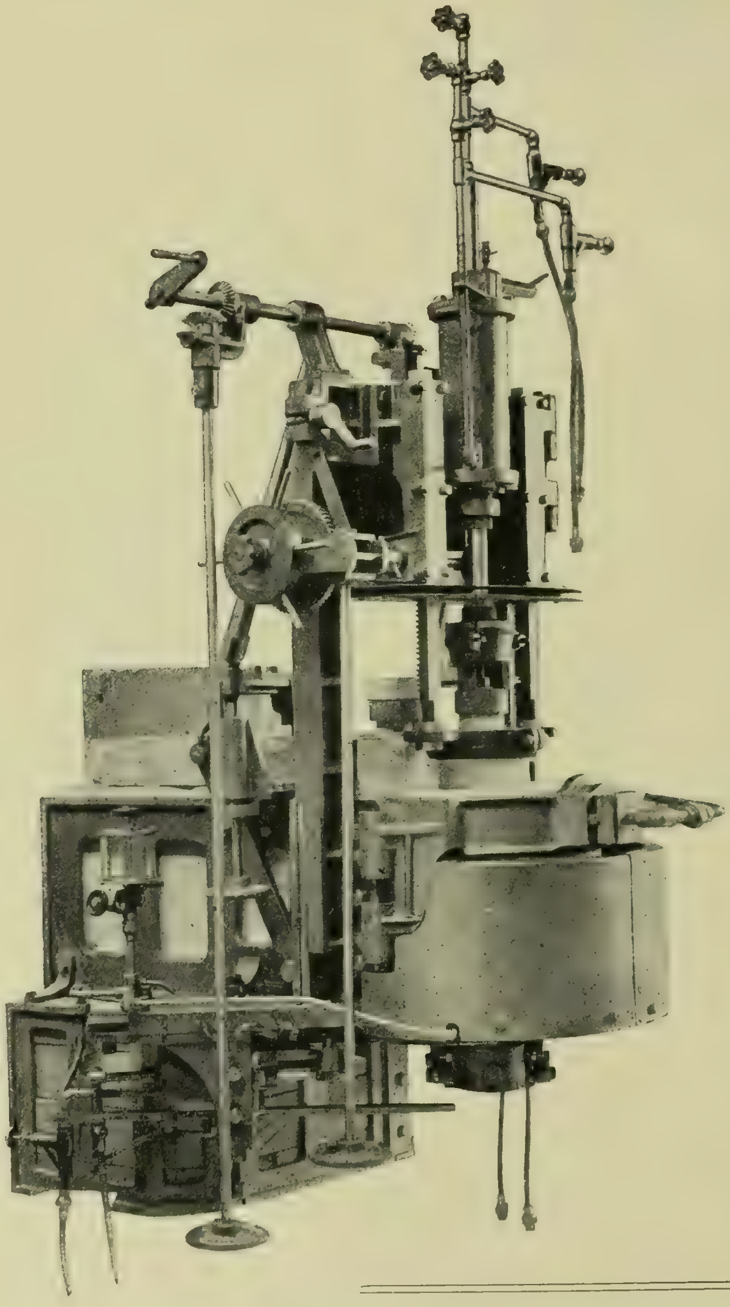
It may be pointed out that a small error in the calculation or determination of those constituents of the glass that possess a high coefficient factor, will have a comparatively large effect on the calculated coefficient of expansion.

The effect on the expansion when one oxide is replaced by another can easily be ascertained by means of the coefficient factors. Suppose, for example, it is desired to determine the effect of replacing 5 per cent. Na_2O by an equal amount of zinc oxide. Since the coefficient factor of an oxide is that proportion of the total expansion assigned to each 1 per cent. of the oxide entering into the composition of the glass, it follows that the effect of replacing each per cent. of one oxide by another is represented by the difference between their respective factors. Thus, in replacing 5 per cent. Na_2O by an equal amount of ZnO, the amount by which the total expansion would be reduced is $5\ (12.9—1.8) \times 10^{-7}$ or, 0.00000555.

* * *

In our resumé of Mr. McIntyre's paper " The Manufacture of Some Experimental Tank-Blocks, and their behaviour in Service " (page 105 in our February issue) it would seem that the phrasing employed is liable to misinterpretation due to the omission of the words " of the remainder." The last few lines should therefore read : " When examined, the sillimanite blocks were almost unattacked, whilst of the remainder, the siliceous ones were generally superior to the others."

The "RANKIN" Automatic Glass Feeder.



RESULTS JUSTIFY CLAIMS.

Claims without justification are futile.

The need for automatic production is admitted by every glass manufacturer. The question is—what mechanism can be installed with the assurance of the best results?

The "RANKIN" record is unrivalled in the Glass Feeder world. Its history is unique. In no instance has a "RANKIN" installation once installed been superseded. On the contrary, wherever it has been adopted, further installations have followed.

The latest proof of this claim is a repeat order for **TWELVE FEEDERS** from a Glass Manufacturing Company, who originally put in one Feeder for comparison with other similar devices. This we believe to be

THE LARGEST INDIVIDUAL ORDER EVER PLACED FOR AUTOMATIC FEEDERS

and represents a great triumph for an All-British Built Feeder.

The mechanism, material and finish are of the highest possible quality. The "RANKIN" Feeder is built for service and will outlast all others.

Demonstrations of the RANKIN AUTOMATIC GLASS FEEDER will be arranged by appointment.

For Illustrations, Descriptive details and terms apply to :

THE RANKIN AUTOMATIC GLASS FEEDER CO.,

1, CHARTERHOUSE STREET, LONDON, E.C.1.

Telegrams : Natiglaso, London.

Telephone Nos. : Holborn, 140 and 141.

The Society of Glass Technology.

The eighty-seventh meeting of the Society was held in the Department of Applied Science, The University of Sheffield on February 17th, 1926.

Some sixteen members met for luncheon before the meeting for which a very long programme was prepared.

In the absence of the President, the chair was taken by Mr. F. G. Clarke. Five new members were elected, three taking advantage of the "Workman Membership" terms which allows workmen and junior technical workers to join at a special rate of subscription. This class of membership has been instituted to stimulate interest in the Society generally, and particularly in the technical papers presented, among workmen and junior staff. One application for ordinary membership was received from Japan, where glass technology appears to be studied assiduously.

Four papers were presented at the meeting, all resulting from research work carried on at the Department of Glass Technology, of Sheffield University. Professor Turner communicated the first paper entitled "**The Influence of Moisture on the Mixing of Batches for Soda-Lime-Silica Glasses,**" by M. Parkin, M.Sc., and Prof. W. E. S. Turner, D.Sc.

Professor Turner stated that although the advantages of dry batch had been readily assumed in the past, it would be well to investigate the advantages, if any, arising from the presence of certain definite quantities of moisture.

The batches investigated were of the type normally used for the production of soda-lime-silica glasses, most of them containing soda ash, limespar, and sand, while certain others contained both soda ash and saltcake.

These materials did not differ very greatly in density, hence the possibility of producing homogeneity on mixing depended mainly on the grain size and on the amount of moisture present. In the whole of the work described the mixing was done by hand. The necessity for sieving the batch subsequent to the usual mixing operation, was well brought out by the experimental results given. After such sifting and remixing, the agreement in composition between two samples of the same batch was generally very good.

The risks attendant upon the use of dry batches was well illustrated, the Professor referring to the distinct segregation which is found to occur with dry materials falling vertically through a distance when charged into a hopper for storage over the doghouse of a tank furnace.

Using batches of from 40 to 50 lbs., the best mixing was obtained when 3 to 4 per cent. of moisture was present.

Further, the influence of the grain size of the materials was studied, and it was evident that, for most batches, the use of light soda ash and very finely ground limespar was to be avoided, due to the tendency to form very hard pellets.

After thanking Professor Turner for his interesting paper, Mr. F. G. Clarke said that it was known in commercial practice that the sand should not be too wet, nor the limespar too fine. He would like to know what would be the results of tests of homogeneity carried out on machine-mixed batches with, and without, subsequent sieving and remixing.

Mr. E. A. Coad-Pryor spoke on the importance of this question of the moisture content of batches, and emphasized the need to mix in small beds when no drying facilities were available. He asked whether moisture had been found to exert any influence on the melting of the batch. He had observed that a batch containing 4 per cent. moisture took twice as long to melt as one containing 1 per cent.

Mr. F. S. Bryson asked that any results which might have been obtained in the Department in connection with the effect of moisture on the melting of batch, be published concurrently with the present work.

In replying to these queries, Professor Turner stated that the influence of moisture on the mixing of batch was only part of the whole story, and that, from some experiments made, the quickest rate of melting these simple batches was obtained with 1 per cent. moisture. The presence of saltcake appeared to make possible a greater addition of water without serious retardation of the melting rate.

The second paper, entitled "**The Effect of Composition on the Viscosity of Glass. Part IV. Calculation of the Influence of Minor Constituents,**" by S. English, D.Sc., was given by the author.

Dr. English pointed out that although the small quantities of impurities present arising both from the batch materials and from the corrosion of the pot, did not seriously affect the physical properties of ordinary glasses, yet they could not be ignored by any investigator comparing the properties. Unlike the thermal expansion and density, the viscosity of glasses did not admit of simple calculation, for the measure of viscosity is desired over a range of temperature, not merely at any particular temperature, and further, viscosity does not always follow the additive law. Dr. English showed, however, that it was possible, from the results published in Parts II and III of this paper (J. Soc. Glass Tech. 1924, 8-206 and 1925 9-83) to calculate corrections to be applied to the value of the viscosity of glasses at predetermined temperatures so as to allow for small differences in composition. Such approximate correction factors were given, and applied to soda-lime-silica glasses, previously used for practical viscosity measurements by the author himself, and Mr. V. H. Stott (J. Soc. Glass Tech. 1925 9-207),

PARKINSON & SPENCER, Ltd.

Ambler Thorn Fireclay Works,
HALIFAX, YORKSHIRE.

ESTABLISHED
1800.

Telephone : No. 1207.
Telegrams : Parkinson & Spencer, 1207 Halifax

Manufacturers of Refractory Goods of every description for the Glass industry, viz :

GLASS-HOUSE POT CLAY, FIRE CLAY, FIREBRICKS, TANK BLOCKS, BINDERS, etc.

Our Tank Blocks are unsurpassed for quality and durability.

WE SPECIALIZE IN BEST POT CLAY MATERIAL.

New Plant recently erected for the cutting and dressing of Tank Blocks to any dimensions.

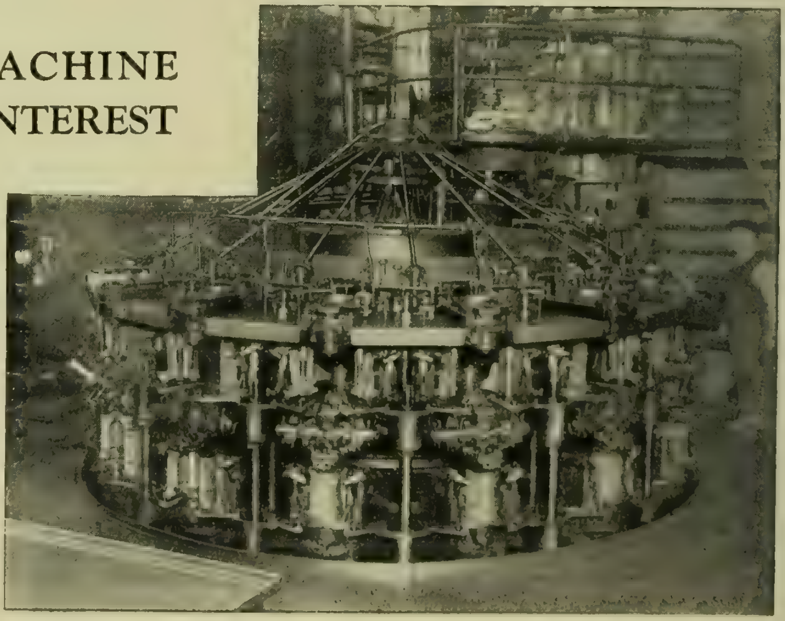
FAVOUR US WITH YOUR ORDERS AND YOU WILL BE SATISFIED WITH RESULTS.

NEW GRAHAM MACHINE CREATING GREAT INTEREST

Offers unusual advantages because of improved construction. Eliminates intermittent rotation which causes wear and tear through jerking. Continuous rotation permits larger production and lower operating costs.

Flexibility of operation appreciated. Produces both narrow and wide mouth bottles in wide range of sizes. Makes push-up bottoms without separate operation.

Three sizes of same construction.
AZ Machine, 15 blank and 15 blow molds
AY Machine, 10 blank and 10 blow molds
AY6 Machine, 6 blank and 6 blow molds
Molds and mold operating parts are interchangeable.



AZ Flow Type—Maximum Speed 72 Bottles per Minute

THE OWENS BOTTLE COMPANY—TOLEDO, OHIO, U. S. A.

Ask us for illustrated catalog, giving complete information.

who had shown that the viscosity results were not in agreement over the whole temperature range.

Employing the corrections calculated by Dr. English, it was obvious that, far from there being any marked divergence between the results of the measurements, there was very close agreement, which was all the more remarkable as entirely different experimental methods were employed by the two workers.

Mr. V. H. Stott said that Dr. English's paper was of great interest, and the author was to be congratulated on the wide range of work covered. He showed that at the higher temperatures, namely, 1300°-1400°, the discrepancy between the viscosity measurements of Professor Washburn, Dr. English, and himself was serious, and he suspected that at these temperatures some error was creeping into the work—perhaps the method of measurement was not reliable, or the calibration factors of the apparatus were not accurately known, or again, the viscosity of glass might vary with the rate of shear.

Mr. E. A. Coad-Pryor remarked that the life of refractories might be influenced by the change in the viscosity of glass resulting from the solution of alumina.

Mr. B. P. Dudding congratulated Dr. English and Mr. Stott on the contribution of such a vivacious discussion.

In reply, Dr. English stated that the actual effect on viscosity of the substitution of alumina for lime in a glass was not thoroughly known, and should be investigated further.

The third paper, by Miss E. M. Firth, B.Sc., F. W. Hodkin, B.Sc., M. Parkin, M.Sc., and Prof. W. E. S. Turner, D.Sc., entitled "**The Function of Arsenic in Soda-Lime-Silica Glasses,**" **Part I**, was read by Professor Turner.

The work done previously on the action of arsenic in, and the extent of its retention in glass was reviewed, and the sum total of the available facts appeared to be that the arsenious oxide was not all expelled during melting, but that a considerable portion remained in the form of the arsenic oxide.

The present investigation was undertaken to ascertain (a) to what extent, and in what form, the arsenic remained in glass; (b) whether or not it assisted in the melting operation and fining operations, and (c) whether or not arsenious oxide acted as a decoloriser.

The results obtained disproved many old-time beliefs, and could be summarised as follows:—

(1) When added to a soda-lime batch, melted in covered pots at about 1400°, arsenious oxide was almost wholly retained when added in quantities not exceeding 10 parts per 1,000 sand; 60% or more was retained when 250 parts As_2O_3 were added to 1,000 parts of sand.

(2) In the absence of any oxidising agent, from 40 to 70% of the arsenic remained in the glass in the form of arsenic oxide.

(3) Arsenious oxide was not found to exert any beneficial effect on the rate of melting, in fact, a higher melting temperature was needed with large quantities of the oxide present.

(4) In quantities greater than two parts per 1,000 of sand, arsenious oxide tended to produce a scum rich in silica, on the glass surface.

(5) Up to 10 parts per 1,000 of sand, the oxide did not exert any beneficial influence on the rate of refining.

(6) Increasing the proportion of arsenious oxide in the glass reduced the green tint due to presence of iron oxide.

(7) Varying opacity was produced by arsenious oxide present to the extent of 150 to 250 parts per 1,000 sand.

Mr. F. G. Clarke remarked that the advantage of the use of arsenic in glass was evidently a debatable point. It was a fact that arsenic rendered less fugitive the pink colour imparted to glass by manganese.

Mr. E. A. Coad-Pryor enquired as to the extent of pot attack by the glasses studied.

Mr. J. H. Davidson asked whether any nitre was used in the batches, as a definite discolourizing action took place under oxidising conditions, arsenic oxide being formed first, then probably a colourless or pale yellow ferric arsenate

In the course of his reply Professor Turner stated that up to 10 parts of arsenious oxide per 1,000 sand, no unusual pot attack was observed, at a temperature of 1400°, but at higher temperatures there did appear to be an increase in corrosion of the pots attendant upon an increase in the arsenious oxide. In normal

(Continued on page 145.

GLASSWORKS PYROMETERS.

FOSTER PYROMETERS
give efficient service under the most severe conditions.

MAY WE SEND YOU PARTICULARS?
Ask for Books Nos. S30 and S31.

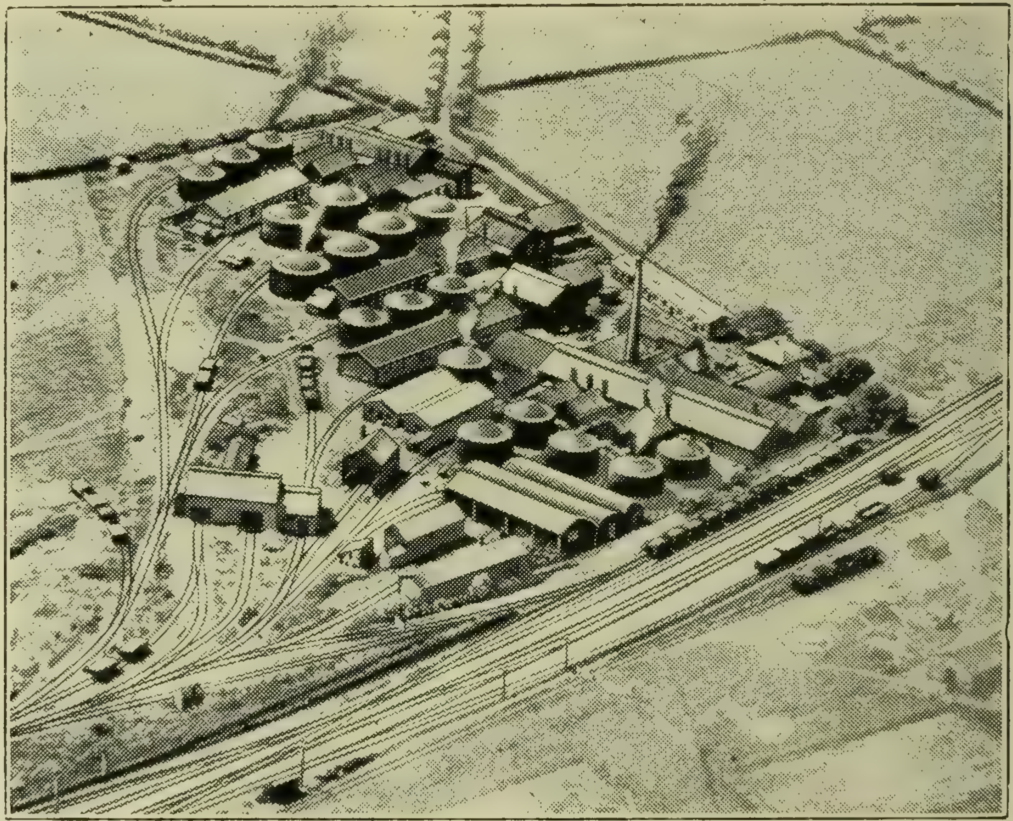
FOSTER INSTRUMENT CO.,
LETCHWORTH, HERTS.
"The Pyrometer People,"

Telephone: Letchworth 26.
Telegrams: "Resilia," Letchworth.

THE MOST DURABLE **BRICK**
MADE FOR **GLASS FURNACES.**

STEPHENS SILICA "C"

EXTREMELY REFRACTORY, TOUGH AND DURABLE.



VIEW TAKEN FROM AN AEROPLANE.

Kiln Capacity 1½ Million Bricks. Works Cover over 9 Acres.

SUPER SILICA CEMENT for setting SILICA BRICK.

Used by most of the principal GLASS WORKS.

STEPHENS & CO., KIDWELLY.

commercial practice the use of arsenious oxide did not give rise to increase corrosion of the refractories. The use of manganese in the absence of arsenic was apt to cause differential colouring throughout the pot.

Owing to lack of time the fourth paper, **"The Function of Arsenic in Soda-Lime-Silica Glasses," Part II. "The Devitrification of Soda-Lime-Silica Glasses containing excessive amounts of Arsenious Oxide,"** by M. Parkin, M.Sc., and Prof. W. E. S. Turner, D.Sc., was taken as read.

The Next Meeting—March 17th, at Stourbridge.

The next meeting of the Society is arranged for March 17th at Stourbridge, the historical centre for the artistic cut glass industry. This town is not visited by the Society every year, and in the past the meetings there have not been among the most successful. Such an admission appears somewhat as a reflection on the Midlands, which stigma will surely be removed next month. Every effort is to be made to make this next meeting popular, with a record good attendance.

It is hoped that it may be possible to arrange a works visit. Mr. Philip Pargeter has kindly invited members to see his collection of glass, particularly Mr. John Northwood's (senior) reproduction of the famous Portland Vase.

The business side of the meeting will be devoted to the reading of papers dealing with a variety of subjects including refractory materials, furnaces and aspects of glass-making particularly interesting to this neighbourhood.

Such a programme, planned for this historical town is specially deserving of support. We are justly proud of our British cut glass, then let us all do our utmost to create a record in the district famous for its production.

In order that members and friends may make the best use of the meeting for social intercourse the Secretary of the Society will be pleased to give any information he can, re accommodation in Stourbridge or Birmingham. V. D.

Membership of the Society of Glass Technology—Its Advantages to all interested in Glass.

All readers may not be conversant with the advantages of membership of the Society of Glass Technology, and it may, therefore, be opportune to state here a few details as to how membership may be gained.

The Society, founded in 1916, aims at the general advancement of glass technology; it receives and discusses papers presented at the meetings, and these papers are published in the Society's Journal. A splendid library, containing valuable books of reference has been gradually built up, and some of these books may not only be referred to in the library, but may also be borrowed for a short period.

The Advantages of Membership.

Every member of the Society is entitled to attend the meetings, to contribute to any discussion, and to suggest subjects of general interest for discussion. He also enjoys the privilege of joining in the visits to works which are arranged from time to time, and this at once opens up an avenue to a wider experience of works practice.

The library is open to all members, who may borrow books for study or reference.

Each ordinary member receives, quarterly, a copy of the Journal containing the proceedings and transactions of the Society, with details of the discussions on papers read, and abstracts of all important papers published elsewhere throughout the world. The Journal is a credit to the Society, and has gained a world-wide reputation. No progressive glass manufacturer, glass worker, or supplier of raw materials can afford to miss copies of the Journal, which keeps a finger on the international pulse of "glass" interests.

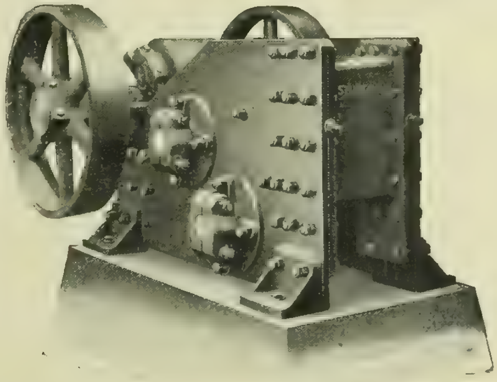
Classes of Members.

Any person interested in the most up-to-date scientific methods of glass-making, and who wishes to further the interests of the Society, particularly in its efforts to encourage and stimulate research, is eligible for membership in one of the four classes.

(a) *Collective Members*—i.e., Firms, Associations, or Institutions engaged in the manufacture, distribution, use, or study of glass.

(b) *Ordinary Members*—i.e., persons interested in glass technology, who do not come under (a), (c), or (d). *Manual, clerical and junior technical workers* are now eligible for membership in this class, at a specially reduced rate of subscription.

Continued on page 147.



For Breaking down Glass Cullet

the Sturtevant Roll Jaw Fine Crusher is the ideal machine. It can be adjusted to give a coarse or fine product, and the mechanism ensures smooth running, slow speed, and the minimum of power

Write for free leaflet G.L. 1541.

STURTEVANT
ENGINEERING
Co. LTD.
149 QUEEN VICTORIA ST LONDON E.C.4.

Telephone:
ROYAL
4208-9

Telegrams:
KAZMILANKO,
LONDON.

SAND

FOR GLASS MANUFACTURE.

FONTAINEBLEAU. BELGIAN. HOHENBOCKAER.

CAZALY MILLS & Co., Ltd.

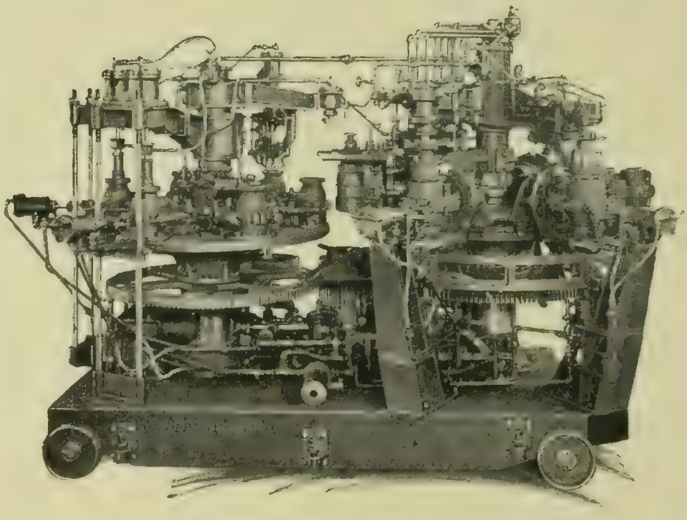
beg to announce
that they are now able to offer regular supplies of guaranteed

FINEST QUALITY FONTAINEBLEAU, HOHENBOCKAER & BELGIAN SANDS

as at present supplied to some of the leading Crystal Glass and Bottle Factories in the U. K.

HEAD OFFICE:
8-9 BYWARD St., LONDON, E.C.3.

BRANCHES:
Liverpool, Glasgow, Hull, Southampton.



The New O'Neill No. 44 Blowing Machine.

A well built, high speed blowing machine with a range from 6 oz. to 40 oz. in capacity. Operating speeds up to 23 per minute depending on the class of ware being made. Have our London representative give you the details.

THE O'NEILL MACHINE CO.,
TOLEDO, OHIO, U.S.A.

LONDON OFFICE: 10 SAVOY ST., STRAND, LONDON, W.C.2.

THE OPTICAL SOCIETY.

At the annual general meeting of The Optical Society, held at the Imperial College of Science and Technology, South Kensington, on Thursday, 11th February, 1926, the following were elected Officers and Members of Council for the session 1926-1927:

President: T. Smith, M.A.; Vice-Presidents: Inst.-Comdr. T. Y. Baker, R.N., B.A.; F. F. S. Bryson, M.B.E., M.A., B.Sc.; R. S. Clay, B.A., D.Sc.; H. H. Emsley, B.Sc.; Treasurer: Major E. O. Henrici, R.E., F.R.A.S.; Secretaries: Prof. Alan Pollard, A.R.C.S., A.M.I.E.E.; F. F. S. Bryson, M.B.E., M.A., B.Sc.; Librarian: J. H. Sutcliffe, O.B.E.; Editor: John S. Anderson, M.A., D.Sc., Ph.D.; Members of Council: D. Baxandall, F.R.A.S., A.R.C.S.; W. M. Brett; W. B. Coutts, M.A., B.Sc., F.R.S.E.; A. H. Emerson; E. F. Fincham; J. Guild, A.R.C.S., F.R.A.S.; E. T. Hanson, B.A.; H. C. Raxworthy; J. Rheinberg, F.R.M.S., F.R.P.S.; G. F. C. Searle, Sc.D., F.R.S.; W. Swaine, B.Sc.; F. C. Watts.

At an ordinary meeting of the Society held at the conclusion of the annual general meeting a paper on **"The Annealing and Re-annealing of Glass," Parts III and IV**, by Mr. W. M. Hampton, B.Sc., A.I.C., was read and discussed.

Part III deals with the determination of annealing temperatures. The formulæ deduced in Parts I and II are applied to the case of heating glass under constant gradient, and the temperature at which strain disappears is obtained, the effect of the known change in the co-efficient of expansion on this temperature being discussed. The calculated and experimental curves are compared, and the effect of changes in the rate of heating and in the size of the specimens is considered.

Part IV relates to the annealing of glass at low temperatures. The annealing equation is considered from the point of view of dimensions. The agreement between theory and experiment is discussed, and an explanation of the discrepancies at low temperatures is advanced. A general expression to cover all cases is deduced which, when applied, agrees well with the results of experiment.

The next paper was by Mr. F. W. Preston on "**The Nature of the Polishing Operation,**" and the author stated that the status of the "flowed" layer on glass, quartz, and similar materials which have been ground or polished is unsatisfactory. The present paper calls attention to a number of phenomena that seem to bear on this subject, and might serve as starting points for interesting researches. The evidence of the existence of a surface layer on polished glass, differing from the underlying material and from the surface layers of ground, or fire-glazed glass, or crystalline surface layers in the case of quartz, is slight or negative. Tests on the interfacial tension, solubility, electric properties, refractive index, or microscopic properties, provide no satisfactory evidence of any distinctive flowed layer, while a study of the rates of abrasion, properties of abrasives used, and defects of polishing suggests that the process is principally one of ultra-microscopic abrasion. It may be a process of abrasion complicated by the fact that the fissures produced by one grain of the abrasive lie in the territory of its neighbour, and that the abrading efforts of the several grains tend to neutralise one another.

SOCIETY OF GLASS TECHNOLOGY.

(Continued from page 145)

(c) *Student Members*—i.e., registered students under 21 years of age, who are attending a course of technical instruction in the United Kingdom.

Subscriptions.

The annual subscriptions are fixed as follows :—

	£	s.	d.
(a) Collective members	3	3	0
(b) Ordinary members	1	10	0
Manual, clerical, and junior technical workers ...	1	1	0
(c) Student members	0	2	6

How to Become a Member.

A postcard sent to the Secretary of the Society, The University, Darnall Road, Sheffield, will ensure a prompt reply covering an application form which is very simple, and presents no terrors of the inquisitions. The signatures of two members are required for ordinary members, unless, in the case of overseas applicants, these are not easily procurable, when the Secretary will accept the form without such signatures. Applications from readers of Glass will be welcomed.

Now Ready!

Volume II

Industrial Furnaces

By

W. TRINKS, M.E.

Fuels, Furnace Types and Furnace Equipment; Their Selection, and Influence Upon Furnace Operation.

The ONLY BOOK *in* ENGLISH *available on this important subject.*

405 PAGES. 292 FIGURES.
27/6 net (Vol 1, 22/6 net)

GLASS PUBLICATIONS LTD.,
TALBOT HOUSE,
ARUNDEL STREET, STRAND,
LONDON, W.C.2.

TELEGRAMS:
"GLASMACHIN, ESTRAND, LONDON.
CABLES:
"GLASMACHIN, LONDON"
CODE:
BENTLEY'S.
TELEPHONE:
CENTRAL 5985.

C. SAXTON, A.M.I.E.E., M. IRON AND STEEL INST., Etc.

CONSULTING ENGINEER

Talbot House,
Arundel Street,
Strand, London, W.C.2.

BOTTLE MOULDS

ORDER YOUR MOULDS FROM

E. LUNN & Co., MOUNT STREET, GLASGOW.

Largest MAKERS of MOULDS in the UNITED KINGDOM

Quick Deliveries and Complete Satisfaction Guaranteed.

MOULDS FOR ALL TYPES OF MACHINES SUPPLIED

ALL MOULDS MADE OF CHILLED CASTINGS ONLY.

Telephone— WESTERN 2792.
Telegrams— GLASMOLD, GLASGOW.

ONE OF OUR RECENT TESTIMONIALS—

"We have one set of Ordinary Round Quart Moulds which you supplied to us which have been working for $2\frac{1}{2}$ years. These are still in perfect condition, showing no cracks or any other flaw in the metal. They have been working almost continuously for the above period, only being off the machines for a week or two at a time. We have also other moulds in Square, Oval and special shapes which have been working quite as long as the Ordinary Round Quarts, although not so continuously, and these also are in perfect condition. We have always found your moulds more satisfactory than any others, and the metal you use is much more durable than any supplied by other firms."

Reference on our Testimonial File : A.B. 91.

Trade "TWENTY MULE TEAM" Mark

Granulated

BORAX

Specially refined for

ENAMELLERS AND POTTERS

BRITISH MANUFACTURE.
Guaranteed 99·50% pure.
Uniform colour and texture.
Free running granules.
No colorific impurities.

BORAX CONSOLIDATED LTD.
16, Eastcheap, LONDON, E.C.3.

TRADE NOTES.

From April 12th to 17th inclusive an Optical Convention will be held in the Imperial College of Science and Technology, South Kensington, London.

An exhibition of instruments, apparatus, etc., etc., of optical interest is being arranged. Full particulars can be obtained from The Secretary, 1926 Optical Convention, 1, Lowther Gardens, Exhibition Road, London, S.W.7.

◆ ◆ ◆

On April 7th Mr. Aylmer Valence, F.S.A. will address the British Society of Master Glass-Painters on "Stained Glass in Houses." The meeting will be held at 5.30 p.m., in the Hall of the Art Workers' Guild, 6. Queen Square, W.C.1.

◆ ◆ ◆

The Society of Chemical Industry is organising a Chemical Congress to be held in London from July 19th to 23rd, inclusive. A series of very interesting papers will be presented and numerous visits to works arranged, whilst the social side is being well looked after.

◆ ◆ ◆

The British Chemical Plant Manufacturers Association, 166, Piccadilly, London, W.1., is organising the first British Exhibition of Chemical Plant to synchronize with this Congress. The Exhibition will be held in the Central Hall, Westminster.

◆ ◆ ◆

In connection with the paragraph we published on page 109 of last month's issue relative to the meeting of the St. Helens Staff of the United Glass Bottle Manufacturers Ltd., unfortunately the paper from which we extracted our notice ascribed to Col. H. Hopgood certain remarks which he did not make. What he actually said was: "I am optimistic. I think we are in for a good time and I am quite certain that the men I have around me will be ready for the boom." Another speaker said there were plenty of lines they had captured from the foreigner, and they were out to push the foreign out of the market altogether. Such being the case, we take this opportunity of expressing our sincere apologies and regrets to both the United Glass Bottle Manufacturers Ltd. and Colonel Hopgood, not only for the mis-statements published by us, but also for our comments which we agree were certainly unjustified.

◆ ◆ ◆

In connection with the Sesquicentennial International Exposition, to be held in Philadelphia, U.S.A. from June 1st to December 1st, 1926, a British Section has been formed with offices at 24, Buckingham Street, Strand, London, W.C.2. Sir Lawrence Weaver, late Director of the United Kingdom exhibits at Wembley, is Chairman of the Advisory Committee.

◆ ◆ ◆

From the official booklet of information just received we notice that the Pittsburgh Plate Glass Company are specifically mentioned amongst a dozen typical great industrial concerns of America.

Mr. Kelaher, the European representative of Wm. J. Miller, Inc., writes us that he has just sold two of the Miller Company's latest type KFO automatic glass feeders, complete with revolving plunger attachments and electric timers to the Irish Glass Bottle Co., Ltd., Charlotte Quay, Dublin, and that he is also remodelling a Miller feeder at Messrs. Jackson's works at Knottingly, Yorks, to incorporate a revolving plunger attachment.

◆ ◆ ◆

The net profits of Borax Consolidated Ltd. for the year 1925 amounted to £425,111, as against £426,192 for 1924. A dividend of 12½ per cent. for the year was declared.

◆ ◆ ◆

The Government have decided not to introduce the Factory Bill this session. It was admitted that certain features of it would of necessity impose further financial burdens upon factory owners.

◆ ◆ ◆

The Government are inviting foreign Labour Ministers to a Conference in London, to discuss the question and possibility of a mutually binding agreement with respect to the details and hours of labour.

◆ ◆ ◆

The Swedish sheet glass works are experiencing difficulties in obtaining orders and it is proposed to assist them by increasing the duty on window glass.

◆ ◆ ◆

There was an increase of approximately £25,000 in the value of glassware imported into Australia during the twelve months ending June, 1925, as compared with the corresponding period for the previous year. The value was £1,236,000.

◆ ◆ ◆

An interesting feature of the British Industries Fairs at London and Birmingham was the general expression of satisfaction by practically all exhibitors. They were undoubtedly the most successful held so far.

◆ ◆ ◆

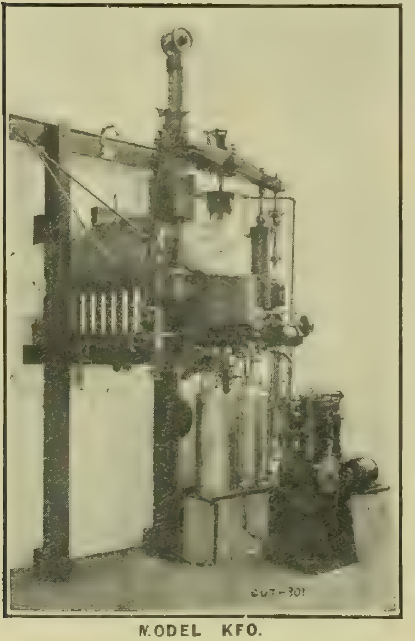
A somewhat curious feature of the Ideal Homes Exhibition now open at Olympia, London, is that, whilst glass and glassware is used on a large proportion of the stands, it is employed to add finish and attraction to the exhibitor's own manufactures or display.

◆ ◆ ◆

According to statistics just issued by the Ford Motor Company, 10,577,261 square feet of rough glass and 9,522,649 square feet of finished glass were produced at their River Rouge works during 1925. This represents an increase of exactly 66⅔ per cent. over the figures for 1924.

◆ ◆ ◆

The statistics recently published by H.M. Stationary Office show that during 1924, Czecho Slovakia supplied the largest proportion of the domestic and fancy glassware imported into Great Britain. Belgium was the largest supplier of plate and sheet glass and Germany supplied most of the bottles.



MODEL KFO.

Latest Miller Feeder

PROGRESSIVELY DEVELOPED SINCE 1907.

By arrangement with **The Morgan Crucible Co., Ltd, Battersea,** a stock of all refractory parts for our feeders is now kept in London.

WILLIAM J. MILLER, Inc., SWISSVALE, PA., U.S.A.
London Office: **366, Strand, London, W.C.2.**
Tel. No.: Regent 5647.
Cables: Autoglasma, Rand, London.
Autoglasma, Pittsburg, Pa.

MOULDS

YOU ARE BOUND to improve the quality and output of your bottles and jars if you use **GOOD MOULDS.**

We supply moulds having the highest possible workmanship and finish. They are produced from the best crucible chilled castings and are machined throughout to precision gauges by practical mouldmakers.

Our service of quick deliveries and guaranteed accuracy in all respects is backed by **LONG PRACTICAL EXPERIENCE.**

We specialise in mould equipment for **LYNCH, MILLER and O'NEILL** automatic machines but any and all types of moulds are undertaken.

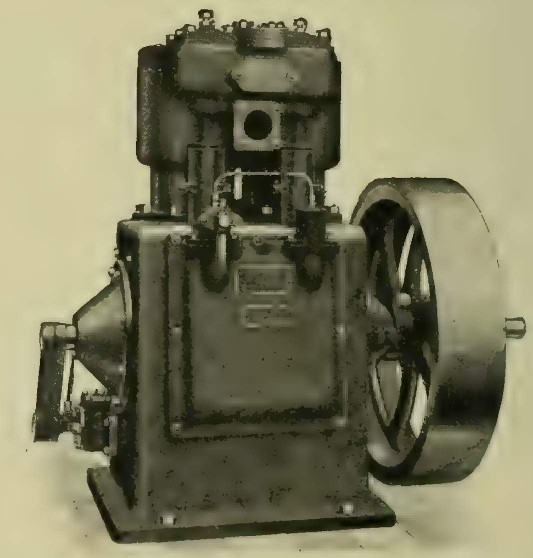
No Order too Large. No Order too Small.

We also supply Glassworks patterns and crucible iron castings of all descriptions.

JOHNSON RADLEY & SONS, Ltd.,
Chesney Works,
Hunslet, Leeds.

Telegrams—MOULDS, LEEDS
Telephone—LEEDS **21354.**

"BROOMWADE"



AIR COMPRESSORS

BRITISH AND BEST

FOR ALL DUTIES.

BROOM & WADE, Ltd., HIGH WYCOMBE.

The Use of Compressed Air—*Continued.*

By ROBERT WILSON.

Reduction in volumetric efficiency due to clearance loss. Fig. 7 represents a theoretical diagram for an air compressor with clearance. A B is the compression line, B C the discharge line, C E the re-expansion line, D A the atmospheric or suction line, F G the line of absolute zero pressure.

Let V = the volume of piston displacement.
CV = the clearance volume, C being the clearance ratio.
EV = the volume of the re-expanded clearance space air.
AV = the length of the effective stroke.
P_1 = the absolute pressure—initial.
P_2 the absolute pressure—final.
r = the absolute ratio of expansion = $\frac{P_2}{P_1}$

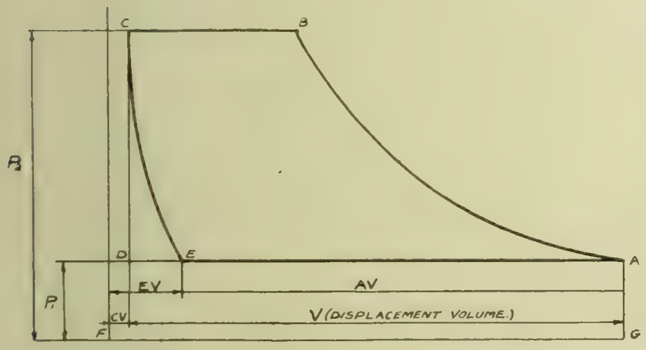


Fig. 7.

Theoretical Diagram of Air Compressor with Clearance.

The total volume of air in the cylinder at the end of the suction stroke, and compressed at each stroke, is

$$V + CV = V\ (1 + C).$$

As the piston recedes on the suction stroke the volume CV, at pressure P_2, expands to volume EV, at pressure P_1, so that the volume taken into the cylinder per stroke is that represented by AV.

Hence

$$AV = V\ (1 + C) - EV \quad \ldots\ldots\ldots\ldots\ldots\ldots\ (17)$$

Assuming first that the re-expansion of the clearance space air is isothermal, then, by transposing equation (5) and calling $EV = V_1$ and $CV = V_2$,

$$EV = CV \left(\frac{P_2}{P_1}\right) = CVr \quad \ldots\ldots\ldots\ldots\ldots\ (18)$$

substituting this value for EV, equation (17) becomes

$$AV = V\ (1 + C) - CV\ r$$

and *the apparent volumetric efficiency*, or the ratio of air drawn into the cylinder to the volume displaced by the piston, is represented by $\frac{AV}{V}$. Therefore,

$$\frac{AV}{V} = \frac{V\ (1 + C) - CV\ r}{V}$$

$$= (1 + C) - C\ r \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (19)$$

If the re-expansion is adiabatic, then by transposing equation (7),

$$EV = CV \left(\frac{P_2}{P_1}\right)^{\frac{1}{n}} = CV\ (r)^{\frac{1}{n}} \quad \ldots\ldots\ldots\ (20)$$

$$AV = V\ (1 + C) - CV\ (r)^{\frac{1}{n}}$$

$$\frac{AV}{V} = (1 + C) - C\ (r)^{\frac{1}{n}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (21)$$

Before proceeding to make use of the assumptions decided upon, it is interesting here to note the effect on the ratio $\frac{AV}{V}$, with isothermal and adiabatic re-expansion. The difference between the two can best be noted from a numerical example.

Example (2). The clearance ratio in a compressor cylinder is 4% of the piston displacement volume. Calculate the *apparent* volumetric efficiency with isothermal and adiabatic re-expansion, when the terminal pressure in the cylinder is (a) 40 lb. per sq. in., and (b) 100 lb. per sq. in., the suction pressure in each case being atmospheric, equal to 14.7 lb. per sq. in. absolute.

For (a) $r = \frac{P_2}{P_1} = \frac{40 + 14.7}{14.7} = 3.72$

For (b) $r = \frac{P_2}{P_1} = \frac{100 + 14.7}{14.7} = 7.8$

Isothermal re-expansion—equation (19).

$$\frac{AV}{V} = (1 + .04) - (.04 \times 3.72)$$

$$= \underline{\underline{.8912}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (a)$$

and

$$\frac{AV}{V} = (1 + .04) - (.04 \times 7.8)$$

$$= \underline{\underline{.728}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (b)$$

Adiabatic re-expansion—equation (21).

$$\frac{AV}{V} = (1 + .04) - .04\ (3.72)^{\frac{1}{1.41}}$$

$$\underline{\underline{.9384}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (a)$$

and

$$\frac{AV}{V} = (1 + .04) - .04\ (7.8)^{\frac{1}{1.41}}$$

$$\underline{\underline{.8680}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (b)$$

These results give the length of the effective stroke as compared with the full stroke, and show that adiabatic re-expansion, if it could be attained, is preferable to isothermal re-expansion. With isothermal re-expansion from 54.7 lb. per sq. in. absolute pressure to a pressure of 14.7 lb. per sq. in. absolute, the length of the effective stroke is only 89.12% of the full stroke, and only 72.8% of the full stroke when the terminal pressure is 114.7 lb. per

New DEVELOPMENTS in GLASS FURNACES:

TEISEN New Wasp-Shape continuous Tank Recuperative Type

with longitudinal travel of flame. The most up-to-date Machine Tank, possessing Stream line features and securing:

- HIGH EFFICIENCY
- LONG LIFE
- CONSTANCY OF TEMPERATURE
- EASY MEANS OF REGULATION
- GOOD ACCESS TO REPAIR TO THE THROAT

TEISEN New T Shape Cross Flame Tank Regenerative Type

For the largest capacities securing:

HIGH OUTPUT WITH ECONOMY OF FUEL by better utilisation of the flame. Designed on the principle of the Modern Open Hearth Furnace.

LET ME STUDY YOUR PROBLEMS.

Individual Attention to all Furnace Matters.

Write Now—

Th. TEISEN, C. E.
Furnace Engineer,
20a, Temple Street,
BIRMINGHAM.
'Phone—Central 1806. *Cables*—TETE, BIRMINGHAM

AIR COMPRESSORS & VACUUM PUMPS

As Illustrated in 5 sizes from 10 to 80 cubic feet per minute

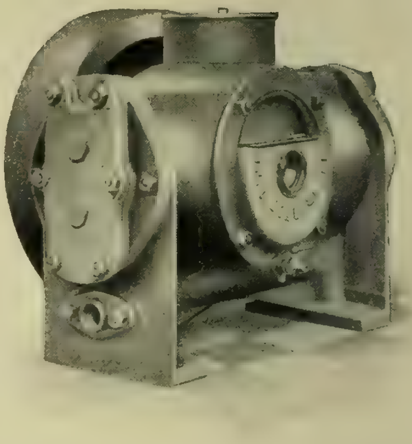
—

Other types Larger sizes

—

Any Pressure or Vacuum

—



LACY-HULBERT & CO., LTD.

BOREAS WORKS, BEDDINGTON
NR. CROYDON, SURREY
Telephone: CROYDON 1698.

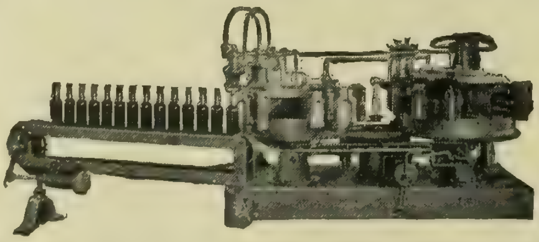
DEFECTS IN GLASS

By Dr. C. J. PEDDLE, M.B.E., F.I.C.

In response to numerous requests we propose publishing in book form this series of articles. They are being entirely rewritten with additional illustrations, and will be published at a popular price.

GLASS PUBLICATIONS LTD., TALBOT HOUSE, ARUNDEL ST., STRAND,——LONDON, W.C.2.

AUTOMATIC



May be Worked on Floor Level—No Pit Needed

NARROW NECK AND WIDE MOUTH
BOTTLE BLOWING MACHINE
No Transfer Boy. No Take-Out Boy.

STRICTLY AUTOMATIC

When Operated with Mechanical Feeding Device. Can be Worked by Hand Gatherers. Speed 10 to 32 Bottles per minute, ranging in size from ¼ oz: to Gallon

LYNCH GLASS MACHINERY COMPANY,
ANDERSON, INDIANA, U.S.A.

Cable Address—"LYNCHNOBOY" ANDERSON
Codes—A.B.C. 5th EDITION, BENTLEY'S, WESTERN UNION

sq. in. absolute. With adiabatic re-expansion the corresponding figures are 93.84% and 86.8% respectively. The results show also that the clearance loss increases as the terminal pressure increases. Further, it will be observed from equations (19) and (21) that the clearance loss also increases as the clearance ratio (c) increases. This will be clear from examples of isothermal re-expansion only.

Example (3). If in example (2) the clearance ratio is 5%, calculate the *apparent* volumetric efficiency with isothermal re-expansion.

(a) — *pressure, 40 lb. per sq. in.*

$$\frac{AV}{V} = (1 + .05) - (.05 \times 3.72) = .8640.$$

(b) — *pressure 100 lb. per sq. in.*

$$\frac{AV}{V} = (1 + .05) - (.05 \times 7.8) = .660$$

Thus, for an increase of 1% in the clearance ratio, the *apparent* volumetric efficiency is reduced from 89.12% to 86.40%, equal to 2.7%, when the terminal pressure is 40 lb. per sq. in., and from 72.8% to 66%, equal to 6.8%, when the terminal pressure is 100 lb. per sq. in.

Apparent volumetric efficiency. The foregoing examples have been given with a view to showing the relative effect of isothermal and adiabatic re-expansion, for different air pressures and different clearance ratios, but as the law for the re-expansion of the clearance air lies between the isothermal and the adiabatic, the length of the effective stroke in practice, generally will be greater than the isothermal value and less than the adiabatic value. By making use of the assumptions decided upon the approximate value of the *apparent* volumetric efficiency can now be calculated.

Example (4). If in example (2) the equation of the law for re-expansion of the clearance air is $P_1V_1^{1\cdot2} = P_2V_2^{1\cdot2}$, calculate the *apparent* volumetric efficiency.

$$\text{Equation (21)} \quad \frac{AV}{V} = (1 + C) - C\,(r)^{\frac{1}{1\cdot2}}$$

Then for (a) — 40 lb. pressure per sq. in.

$$\frac{AV}{V} = (1 + .04) - .04\,(3.72)^{\cdot833}$$

$$= .9205 = 92.05\%$$

and for (b) — 100 lb. pressure per sq. in.

$$\frac{AV}{V} = (1 + .04) - .04\,(7.8)^{\cdot833}$$

$$= .8186 = 81.86\%$$

It has been explained that these results are more likely to represent the length of the effective stroke of an air compressor under actual working conditions than are the results obtained for isothermal and adiabatic re-expansion, but it has been explained also that re-expansion other than adiabatic results in a temperature at the end of re-expansion which is higher than the temperature at the beginning of compression and, consequently, that the temperature of the incoming air is raised by mixing with the re-expanded clearance air. Therefore, the cylinder, at the end of the suction stroke, will be filled with air at a temperature higher than that of the atmosphere, the effect of which is to reduce the volumetric efficiency in proportion to the rise in temperature (absolute) of the incoming air.

Reduction in volumetric efficiency due to initial heating. It has been explained that the factors which determine the law of expansion are the temperatures at the beginning and end of the process, so that even if the equation for the law of re-expansion is assumed to be $P_1V_1^{1\cdot2} = P_2V_2^{1\cdot2}$, it is necessary to make an assumption for the final temperature of compression before it is possible to calculate the probable temperature at the end of re-expansion.

Part of the cooling which takes place during the discharge of the compressed air from the cylinder, probably results in the temperature at the beginning of re-expansion being less than the final temperature of compression, so that no considerable error would occur if the theoretical adiabatic final temperature of compression was assumed to be the temperature at beginning of re-expansion. This means that the initial temperature of compression is assumed to be equal to the temperature of the atmosphere.

Example (5). Suppose the air drawn into the compressor cylinder to be at *atmospheric temperature* and pressure, equal, respectively, to say 60°F, and 14.7 lb. per sq. in. absolute. If compression is assumed to be adiabatic, calculate the final temperature of compression (t_2) when the final cylinder pressure is (a) 40 lb. per sq. in., and (b) 100 lb. per sq. in.

$$\text{Equation (8)}\ T_2 = T_1 \left(\frac{P_2}{P_1}\right)^{\frac{1\cdot4 - 1}{1\cdot4}}$$

$$\text{Then}\ T_2 = 60 + 460 \left(\frac{40 + 14.7}{14.7}\right)^{\cdot29} = 761.5$$

$$\text{Therefore,}\ t_2 = 761.5 - 460 = 301.5^\circ\ \text{F.} \quad \ldots\ldots\ldots \quad (a)$$

$$\text{Also}\ T_2 = 60 + 460 \left(\frac{100 + 14.7}{14.7}\right)^{.29} = 944$$

$$\text{Therefore,}\ t_2 = 944 - 460 = 484\ \text{F.} \quad \ldots\ldots\ldots\ldots \quad (b)$$

Example (6). Suppose the temperatures at the beginning of re-expansion to be as calculated for example (5), and that re-expansion of the clearance air follows the law $P_1V_1^{1\cdot2} = P_2V_2^{1\cdot2}$, calculate the temperature (t_1) at the end of re-expansion.

$$\text{From equation (8)}\ T_1 = T_2 \left(\frac{P_1}{P_2}\right)^{\frac{1\cdot2 - 1}{1\cdot2}}$$

$$\text{then for (a)}\ T_1 = 761.5 \left(\frac{14.7}{54.7}\right)^{\cdot166}$$

$$= 613$$

$$\text{Therefore,}\ t_1 = 613 - 460 = 153^\circ\ \text{F.}$$

$$\text{(b)} \quad T_1 = 944 \left(\frac{14.7}{114.7}\right)^{\cdot166}$$

$$= 671$$

$$\text{Therefore,}\ t_1 = 671 - 460 = 211\ \text{F.}$$

Thus, it is apparent, that if compression commenced with the temperature of the air equal to that of the atmosphere, this could not be maintained for long, even if the rise in temperature was due only to the incoming air mixing with the re-expanded clearance air.

There is, of course, the additional heating due to the incoming air taking heat from the hot metal surrounding the cylinder.

(It might be supposed that the temperature at the end of the suction stroke would continue to increase the longer the air compressor was running, but such is not necessarily the case, even if the compressor is running for long periods on full load. Two factors operate to limit the increase in temperature due to initial heating; viz. (1) the cooling water jackets, and (2) the short period for which the incoming air is in contact with the hot metal. When a plentiful supply of cold water is available for circulation in the water jackets, the cooling effect increases as the difference in temperature between the metal and the water increases. Thus, the metal reaches a temperature which, by reason of the heat absorbed by the water, is never exceeded, so long as the circulation is maintained; and since the maximum temperature of the metal is thus limited, the heat given up by the metal to the air is also limited, so creating an initial temperature which is practically constant).

Example (7). If in example (2) the temperature of the atmosphere was 60° F, but, due to contact with the hot valves and metal, the incoming air is heated to 70° F before mixing with the re-expanded clearance air, estimate (1) the probable temperature in the cylinder at the end of the suction stroke (T—initial), and (2) the reduction in volumetric efficiency resulting from the initial temperature of the air in the cylinder being higher than that of the atmosphere.

(1) Probable temperature in the Cylinder.

From Fig. (7) the volume occupied by the re-expanded clearance air is EV, and

$$EV = V + CV - AV \quad\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (22)$$

$$\text{also } EV + AV = V + CV \quad\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (23)$$

40 *lb. pressure per sq. in.*

Since the value of V, in example (4), was 1, the value (.9205) obtained for AV in that example can be substituted in equation (22).

$$\text{Therefore } EV = (1+.04) - .9205$$

$$EV = .1195$$

Substituting this value for EV, equation (23) becomes

$$.1195 + .9205 = 1 + .04$$

Multiplying by 100, the above equation becomes, say

$$12 + 92 = 104$$

or reducing the equation to easily handled numerals, to

$$1 + 7{\cdot}7 = 8{\cdot}7$$

Thus, if the volume of the re-expanded clearance air is one part of the total cylinder volume, the volume of the air drawn into the cylinder is 7·7 parts.

If the temperature of the air at the end of re-expansion is as obtained from example (6), viz. 613° F absolute, and the temperature of the air drawn into the cylinder is 70° F, equal to 530° F absolute, then the total cylinder volume consists of one part at 613° F absolute, and 7·7 parts at 530° F absolute. That is

$$(1 \times 613) + (7.7 \times 530) = 8.7 \times T\ (\text{initial}).$$

$$\text{therefore } T\ (\textit{initial}) = \frac{613 + 4081}{8.7}$$

$$\text{say } 540^\circ \text{ F. absolute} = 80^\circ\text{F} \quad\ldots\ldots\ldots\ldots\ldots (a)$$

100 *lb. pressure per sq. in.*

Substituting in equation (22) the value for AV as obtained in example (4), then

$$EV = (1+.04) - .8186 = .2214$$

and from this, equation (23) becomes,

$$.2214 + .8186 = 1.04$$

Multiplying by 100, these values, become, say

$$22 + 82 = 104$$

$$\text{or } 1 + 3{\cdot}7 = 4{\cdot}7$$

The temperature at the end of re-expansion, from example (6) is 671° F absolute, and that of the air drawn into the cylinder is again 530° F absolute, so that

$$T\ (\text{initial}) = \frac{671 + (3{\cdot}7 \times 530)}{4{\cdot}7}$$

$$560^\circ\text{F. absolute} = \underline{100^\circ \text{ F.}} \quad\ldots\ldots\ldots\ldots (b)$$

(2) **Reduction in volumetric efficiency due to initial heating.**

Now, as the volume of air at constant pressure varies in direct proportion to the absolute temperature it follows that

$$V_i = V_a \left(\frac{T_i}{T_a}\right) \quad\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (24)$$

when Va is the volume of air at atmospheric temperature Ta, Vi is the volume of air drawn into the cylinder, and Ti is the initial temperature.

Therefore, the reduction in volumetric efficiency resulting from the heating of the air drawn into the cylinder, would be as follows:—

From equation (24)

$$\frac{V_a}{V_i} = \frac{T_a}{T_i} \quad\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (25)$$

40 *lb. pressure per sq. in.*

$$\frac{V_a}{V_i} = \frac{520}{540} = \underline{\underline{.963}} \quad\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (a)$$

100 *lb. pressure per sq. in.*

$$\frac{V_a}{V_i} = \frac{520}{560} = \underline{\underline{.9285}} \quad\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (b)$$

(To be continued.)

On February 12th Mr. Walter Butterworth, M.A., J.P., the new President of the Lancashire and Cheshire Antiquarian Society, delivered an address on "Characteristics of Stained Glass" at a meeting of the Society held in the great hall of the Chetham's Hospital, Manchester. The speaker traced the history of stained glass from its beginnings to the period of its greatest magnificence, the first half of the sixteenth century.

The lecture was illustrated by a large number of lantern slides of windows in cathedrals and churches, both in this country and abroad.

Mr. Butterworth is Managing Director of Messrs. Butterworth Bros., Ltd., Newton Heath Glass Works, Manchester.

◆

The annual dinner of the Society of Glass Technology will be held on May 19th.

The Corrosion of Glass Surfaces.[*]

By GEORGE W. MOREY.[†]

(*Continued*).

The methods fall roughly into two classes; first, those in which the glass is tested under service conditions, or some approximation thereto, relying either on an extended time to bring out the differences or on sensitive methods of treatment; and second, those in which the action of the reagent is accelerated by heating. The first group of methods undoubtedly gives the more unequivocal results. Among the results of such methods may be included the large amount of experience that has been gained in practice as to the glass compositions stable enough to be used in optical instruments, either with or without protection, as to the types of glass that have proved serviceable as window and gage glasses, and as to those compositions that have proved serviceable for chemical laboratory glass. In the same group of methods are to be included the many tests that have been carried out on the relative resistance to attack by various common laboratory reagents, such as the work of Walker and Smither[‡], the results of which are directly applicable to laboratory work. The methods based on the use of sensitive indicators are also to be included in this class, though the results of such tests are to be accepted with caution. Foremost among these methods is the iodeosine test developed by Mylius. In this method a fresh surface of known area of the glass is immersed in an ether solution of iodeosine. The alkali in the glass reacts with the dye, forming a soluble salt, which is dissolved in water, and the colour compared with a standard. This gives excellent results with the usual soda-lime and potash-lime glasses, but may give wholly misleading results with glasses rich in boric oxide or with glasses containing little alkali but much lead oxide, or barium oxide, whose salts with iodeosine are not soluble in water. Results obtained by treating powdered glasses with water or with dilute acid are also to be accepted with caution. In all such cases the reactions taking place are decomposition reactions, in which the end results will be complete decomposition of the glasses. What is determined is roughly a rate of reaction, and of a reaction particularly susceptible to variations in the experimental conditions. This is the clue to the lack of concordance in the observations recorded in the literature. The data given refer, not to solubility, but to rates of reaction, frequently determined under poorly defined conditions.

The second type of testing method, in which the process is accelerated by increasing the temperature, is subject to the same limitations. In addition, we have here the possibility that the type of reaction between glass and water may be completely altered, as is the case with potassium disilicates in contact with water. Although such temperatures have been reached in high pressure bombs, it is not probable that they will be reached with complex glasses in the type of autoclaves used in testing, but nevertheless it must be born in mind that the processes taking place at high temperatures and pressures differ greatly from those that take place under more ordinary conditions. One important difference is the tendency of the silica to pass into colloidal solution. This is marked at low temperature, but when the temperature is raised to 200°-300° C. there seems to be no tendency to form colloidal solutions, but rather for the silica to crystallize as quartz.

Effect of Chemical Composition.

The correlation of the ability of glasses to withstand the corrosive action of water with their chemical composition is difficult, as is to be expected from the complex character of the processes involved. The one outstanding feature is the superiority of silica glass over all others; indeed it may be said, as a rough generalisation, that the chemical resistivity of a glass is proportional to its silica content. Addition of other substances is necessary, however, to lower the temperature required in the melting process to one conveniently attainable in practice, and in glasses used for certain special purposes, such as optical glasses, for the attainment of other desirable qualities.

Of the substances commonly introduced, the alkalies soda and potash, occupy a special place in the increased fusibility they give to glass, and few glasses are made which do not contain one of these oxides. They also are especially noteworthy in their deleterious effect on the resistivity of glass to corrosion, and it may be stated as another rough generalisation that the power of a glass to resist corrosion is inversely proportional to the alkali content. Of the two oxides, potash usually exerts the greater effect, but a mixture of the two oxides is superior to either alone. This has been especially well brought out by the work of Peddle,[*] who showed that in the alkali-lead oxide glasses " to obtain the maximum of durability in an alkali-lead-silicate glass the best proportions in which to mix the alkalies is the ratio of 7 parts of the potash to 3 parts of soda." No explanation has been offered for this remarkable circumstance.

Of the three oxides, magnesia, lime, and barium oxide, the last is inferior to the others in the resistivity that it confers upon glass. Although glasses high in barium oxide and excellent in resistivity are well known, the excellence is to be ascribed to other ingredients. Between magnesia and lime there is little choice, each surpassing the other under certain conditions, but the difference never being marked. As far as the writer is aware, no work has been done on a possible advantage of mixed magnesia-lime glasses, similar to the marked advantage found with the mixed soda-potash glasses.

---

[*] Paper presented before the Division of Industrial and Engineering Chemistry, at the 69th Meeting of the American Chemical Society, April 6th-11th, 1925.

[†] Geophysical Laboratory, Washington, D.C.

[‡] Bur. Standards, Tech. Paper 107.

[*] J. Soc. Glass Tech., 5, 195 (1921).

Lead oxide is superior to the alkali oxides but slightly inferior to lime from the point of view of resistance to corrosion. However, lead oxide can be introduced in much larger quantities than can lime without devitrification, and the high lead glasses thus obtained are excellent for chemical resistivity, until the very heavy lead glasses are reached, and even these are good as regards resistance to water alone.

It seems to be a general rule that glasses complex in composition are superior to the simpler ones, as, for example, the mixed alkali glasses. Certain substances rarely present in large quantities seem to be of special value in this connection, among which are zinc oxide, boric oxide, and alumina. Pure zinc oxide glasses are not highly stable themselves; yet the addition of zinc appears to have a distinctive favourable effect in certain cases. Boric oxide is a constituent of many, if not most of the best glasses; indeed, Pyrex glass, which is distinctly superior in this respect, contains a considerable quantity of boric oxide. Alumina is also of great value in enhancing the stability of glasses, a content of as little as 1 or 2 per cent. having a markedly beneficial effect. The dense barium crowns would probably be much inferior glasses were it not for their very considerable content of alumina, but as manufactured they rank with the best.

Resistivity of Glass.

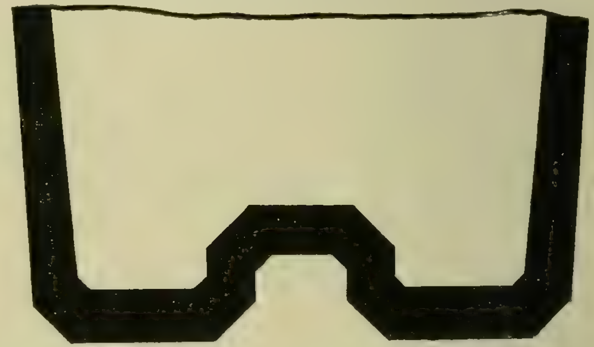
The preceding discussion has dealt with the action of water alone, but frequently the resistivity of glass to the action of aqueous solutions is of importance. In many cases the solutions are dilute enough so that the differences caused by the dissolved material are not significant, but this is not always true. In regard to the end results, on attaining equilibrium the presence of dissolved salts or of acids or alkalies is not of much significance. Whether or not such substances are present, the decomposition will tend to go on until decomposition of the glass is complete. But the presence of an acid or alkali will often profoundly affect the rate of decomposition, which is the subject of primary interest here, and the effect will be largely dependent both on the composition of the glass and on the dissolved material. Decomposition of most glasses by water results in the liberation of alkali, by the process just outlined for the potassium silicates, and the liberated alkali often accelerates the further decomposition of the glass. For this reason some types of glass, notably those high in silica, or in silica and boric oxide, are more resistant to acid solutions than to water, and more resistant to water than to alkalies. On the other hand, glasses low in silica are usually more rapidly attacked by acid solutions; indeed, wollastonite glass, $CaO.SiO_2$, and extra heavy lead glasses can be decomposed rapidly enough for analytical purposes by digesting with hydrochloric acid. The action of concentrated solutions of salts and acids is often in harmony with the views of Foerster,* who assumed that the acids exert no direct action on the glass, and that the attack is due exclusively to water. This view leads naturally to the conclusion that a large amount of acid weakens the attack by diminishing the concentration of water.

---

* Z. Instrumentenk., 13, 457 (1893).

NEW DESIGN OF GLASS-MELTING POT.

An improved design of melting pot, for which numerous advantages are claimed forms the subject of patent applications in many countries by H. Schnurpfeil, of Carlsbad, Czecho-Slovakia. As everyone is aware, there has been little, if any, change in pot design for many years, and the present modification is so simple that one wonders it has not been previously applied.



Briefly, it consists in replacing the usual flat bottom by one provided with a deep slot, or "flue," as shown in the diagram above. This construction not only gives an increased heating surface in the bottom of about 33 per cent., but also allows the hot gases to pass under the pot and thus further the melting process.

According to the inventor, tests have shown that the new pot enables a saving of 20 per cent. in fuel to be obtained, whilst at the same time the melting process is shortened by 20 per cent. We are informed that manufacturers who desire to adopt this new construction should communicate with the inventor regarding license, etc.

Vitreous Enamel Colours.
Stains for Glass.
Oxides for Colouring Glass Metal.
Selenium Metal.
Selenate and Selenite of Soda.

GROUND BONE, FELSPAR, FLINT, FLUORSPAR, QUARTZ, STONE, WHITING, ETC.,
CARBONATE & SULPHATE OF BARYTES
OXIDES OF ANTIMONY, ARSENIC, CHROME, COBALT, SMALTS, COPPER, IRON, MANGANESE, NICKEL, TIN, TITANIUM, URANIUM, ZINC, ETC
TRADE CERAMIC MARK
WENGERS, LTD.
CERAMIC COLOURS & CHEMICALS
ETRURIA.
STOKE-ON-TRENT.
England.
COLOURS FOR POTTERS, GLAZED BRICK MANUFACTURERS, & GLASSMAKERS.
Samples & Price Lists Sent on Demand
PREPARED ENAMELS FOR CAST & SHEET IRON, COPPER & JEWELLERY,

Limespar.
Phosphate of Lime.
Nitrate of Soda.
Nitrate of Potash.
Opavetro for Opacifying Glass.
Alumina, Oxide and Hydrate.

The Source of the Coloured Glass used in Mediaeval Stained Glass Windows.

By JOHN A. KNOWLES.

Until Utynam came to England in 1449 at the instance of Henry VI to make " glass of all colours " there is no evidence of this art having been previously carried on in this country. Indeed the grant of protection then given to him expressly states that " the said art has never been used in England." It also states that Utynam had not only come to make coloured glass, but also to teach others to do the like.

The venture does not seem to have proved a success. Although Utynam had been brought here by the king himself, it would seem that those about the court, and even Henry's own relations, regarded the venture as an experiment, the success of which was in the highest degree problematical. Moreover, they probably had knowledge of an earlier attempt which had been tried two years previously, and had turned out a failure. For in 1449, the same year in which Utynam " returned " to England, Warwick " the King Maker" who was Henry VIths cousin, married Anne Beauchamp, daughter of Richard, Earl of Warwick, to whose memory the windows of the Beauchamp Chapel at Warwick, the contract for which had been drawn up in 1447, were being erected. Indeed, it would seem that this was a second attempt to establish a native industry of coloured glass manufacture, and that Utynam had two years previously attempted it and failed. For he is spoken of in the grant as having " returned to England." This first venture is probably referred to in the contract drawn up in 1447 between the executors of the Earl of Warwick and the King's own glass-painter, John Prudde of Westminster, all of whom would be in possession of the facts, in which it was expressly stipulated that " no glasse of England " was to be used. In any case the venture evidently proved a failure, for we hear no more of coloured glass made in England until 1751.

From an early date it would seem that glass was a regular form of imported merchandise. For, as Prof. Ashley points out (Introd. to " Eng. Econ. Hist. & Theory " pt. 1, p. 70), as early as the 10th and 11th centuries commerce with the Frankish kingdom had long been carried on from London and the ports of Kent, especially Sandwich and Dover, and the connection with the Scandinavian countries caused by Canute's conquest, brought York, Grimsby, Lincoln, Norwich, Ipswich and many other ports along the eastern coast into active commercial communication with the Baltic countries. The wares which, in an old English dialogue, the merchant describes himself as bringing, included " purple cloth, cloth, silk, costly gems and gold, garments, pigments, wine, oil, and glass." (Turner 113).

The glass workers brought over from France and Germany by Benedict Biscop and Cuthbert of Jarrow, in the seventh and eight centuries, were, as likely as not, glass-painters and window-makers and though some of them might be, and indeed were, glass-makers, they would, as likely as not, only attempt the making of white glass; such a highly specialised manufacture as "coloured glass " would be beyond their capabilities.

If, therefore, as there is good reason to believe, the coloured glass was imported, the question naturally arises where did it come from, by whom was it made, and by what means and routes was it brought to England? Here we enter upon a highly speculative subject, as there is little direct evidence and but few notices, and these very incomplete, to guide us. There are several reasons for this. For one thing, although we know that in several districts where conditions as regards abundance of fuel, availability of raw materials and transport of finished product to a market, were favourable, glass-making was carried on; yet the exact place where the works were situated is practically unknown. This is largly accounted for from the fact that glass-making could have no permanent habitat, like an industry such as weaving enjoyed in places such as Bruges or Arras. It was essentially a nomadic industry, depending almost entirely on the facility with which abundant fuel to feed its ever hungry furnaces might be procured and when all the timber within easy reach had been burnt, the glass-makers had to move to where more could be found close at hand.

This is clearly shown in George Longe's petition to Burghley (Lansdowne MS. No. 59, art. 72, printed in " Hartshorne Old English Glasses," p. 403), in which he complained that " Men erected and set on worke divers glass-houses in sundry parts of the Realme, and having spent the Woods in one place do dayly so continue erecting newe Workes in another place without checke or controule."

One would not at first sight look upon a glass works as a thing which could be easily moved, but indeed it was so. The mediæval glass furnace was only a small affair, and if by reason of wars or other causes the glass-makers were driven from one place; they set up without more ado in another. Rimangia, a glass-painter of Paris refers to this in a letter written about the year 1640 to the Chapter of the Cathedral of Auch. He tells us that as a result of the wars which then devastated Lorraine, the glass-makers had " all gone away on account of the wars in the country and all the furnaces are thrown down," but he added, " they have gone away into other places where they are making glass as good as was made in Lorraine." (L'Abbe' Caneto. " Sainte Marie d'Auch," roy, fol. 1857, pp. 69-70).

In this way there was scarcely time for anything in the way of a " manufacturing " centre, or even a small village to grow up around the glass works, from which it could receive a name derived from the industry which had given it birth. Even if this did occur, the place would speedily fall into decay, eventually be abandoned, and its name forgotten as soon as the industry upon which it depended had moved elsewhe e. In some few cases, place names have survived, which show that at one time the town or village had been a centre of glass-making. Place names of several towns and villages in France such as Vitry, Vitre', Vitrival, Vitry-le-Brule, Vitry sur Marne, Les Verrieres, etc. show this, as also do such names as Glasshouse of which there are more than one in England. The survival, however, cannot be anything but exceptional. It was no doubt due to circumstances such as for example, that the works were situated on a river and therefore wood for fuel could be cut and floated down from points higher up long after the local supply had been exhausted. No doubt in other cases the village or town has managed to survive through having carried on some other industry, by which it was enabled to exist after its original means of livelihood had ceased. Another reason why so few definite notices of names of places where the coloured glass was actually made have been preserved, is found in the fact that glass-painters and cathedral authorities in England, at any rate, for obvious reasons never dealt with the glass-makers direct. For glass, like articles of commerce, reached its eventual destination after passing through many hands, and be devious routes. It was made in backwoods and next-to-inaccessible places, whence it would be floated down rivers in barges or on rafts to the nearest centre of civilisation and trade. It was there bought by the trading agent of a shipper, despatched to the nearest port by road or river (whichever afforded the easiest mode of transit), shipped overseas by the agent of the Hanse or merchant adventurer, warehoused at the port of entry, and, after paying customs dues, was finally sold by the importer to the glass-painter. In fact the process was exactly similar to that by which almost in our own day the pelts of the Canadian fur-bearing animals reach the English furrier who dresses them.

It is evident, therefore, that the question of the source of the coloured and much of the white glass used in mediæval windows opens up a rather wide field of research, and enquiry, much of which is mere speculation, and may seem to many as somewhat wide of the subject of glass-painting.

But whilst there will always be those who prefer that any subject that is presented to them for study shall be boiled down to essentials, compressed to the narrowest limits, and the exuding essence doled out in the manner which correspondence schools make such a feature of others prefer to take a larger view, and to such the following notes may prove of interest.

The sources of glass most frequently mentioned in mediæval documents and account rolls, stated in the order of their most frequent mention, are Burgundy, Lorraine, Normandy, Hessian, Dutch and Venice. The first two, Burgundy and Lorraine have denoted such diverse political and geographical areas at different periods of history, as to make it a matter of no little difficulty to determine exactly what particular district was intended. In the tenth century the name Lorraine was applied to the whole country north of France, from the upper Rhine westwards to the sea; whilst Burgundy comprised the whole of the Rhone Valley. After the eleventh century Lorraine fell into two halves; the Duchy of Upper Lorraine which alone retained the name and which included the country watered by the upper course of the Meuse and Moselle; bounded north by the Ardennes, south by the tableland of Langres, east by the Vosges and west by Champagne. The other half became split up into numerous states, all of which are practically included in the modern Belgium. The application of the name Burgundy, on the other hand—called after the thirteenth century the kingdom of Arles—was at a later date restricted to the countship which included the district between the Jura Mountain and the Saone (in later times called Franche-Comte) and to the duchy which had been created by the Carolingian kings in the portion of Burgundy that had remained French. Normandy comprised the portion of north western France, originally belonging to the English crown, through which passed the Seine on its way to the sea, and having for its port and capital Rouen. Hesse was that portion of the empire stretching in a north-easterly direction between the upper reaches of the Rhine and Weser, the city of Mainz, early connected with the history of English glass-painting, although actually situated on the opposite bank of the Rhine being practically its most southern extremity. Dutch glass, although a considerable article of commerce in later times, was evidently little used in the fifteenth century and the term was probably applied to glass manufactured higher up the Rhine and Maas rivers, and exported from a Dutch port, whilst Venice glass was of still less account.

The notices of places where sheet glass was actually made are scanty, nor is the kind of glass, whether window glass or hollow ware, hardly ever described. It is, of course, evident that in districts suitable for glass-making, factories would be established, some of which made one kind and some another, whilst some would even make both, but it should be remembered in this connection that until the end of the fifteenth century the demand for window glass would far exceed that for glass vessels, and therefore the greater number of factories would be devoted to that form of manufacture. It was not till later that the demand for glass ware for articles of domestic use exceeded the total amount of window glass manufactured. During the middle ages, glass vessels, even in the houses of the wealthy, and the palaces of kings, as inventories prove, were comparatively rare, whereas the demand for glass to fill the acres of window space in the churches, cathedrals and monasteries must have been enormous. A drinking vessel need not necessarily be transparent; it can, and generally was, made of metal, earthenware, wood or even leather, whilst a window must be of glass. Yet, whilst there is little authority, there is plenty of circumstantial evidence as to where glass works existed, their situations being controlled by several considerations practical and geographical.

In the first place an abundant supply of easily obtained wood of the right kind was an absolute necessity. Glass works were therefore situated in forests, and as near some source of alkali, such as a fern heath afforded as possible. Owners of moors and forests were accustomed to let the privileges of cutting timber and collecting the bracken, the rent being paid in glass ware for their tables. Thus, in 1338 Humbert, the Dauphin, granted a part of the forest of Chamborant to a glass worker named Ginonet, on condition that he should supply him with vessels of glass; and in 1446 the abbess of St. Croix of Poitiers received a gross of glasses from the glass works of La Ferriére in return for the right of gathering fern for the manufacture of potash. (Nesbitt. Art. " Glass. Encyclo. Britt." 11th ed.).

The above instances do not show that the glass works named were necessarily employed exclusively or at all in the manufacture of hollow ware—on the contrary any sheet glass-maker can blow a vessel, and glass manufacturers would find it cheaper to settle for rent in kind than to pay in money. Glass vessels are always being broken, and therefore more are required, so that this constituted a form of exchange between landlord and tenant, acceptable to both. For sheet glass the landlord, his windows once being filled, would have no use.

But it is useless to make glass unless it can be got to market. The glass-maker, situated as he was in the midst of forests probably dozens of miles from the nearest road, or more probably with only a cart track, difficult at the best of times, and impossible in anything like wet weather, kept close as might be to a river. Glass is heavy, and if the mediaevals had had to rely upon roads to transport it, it is safe to say that the huge perpendicular windows could never have been planned; but must have always remained as small as those of the Norman period on account of the impossibility of finding glass enough to fill them. For in the fifteenth century roads were not only few and bad, but were infested with highwaymen and criminals, who having been ordered out of the country, were making for the nearest port, and who robbed and murdered all but those who travelled in large parties and armed to the teeth.

But rivers afforded a safe and easy means of transit for heavy goods, besides leading direct to the destination—a port where the finished products could be sold and fresh material in the way of rare chemicals and minerals required for the making of still more glass be obtained. The ports themselves, such as Bruges, Rouen, Bordeaux and Marseilles, were as in our modern instance of Quebec and Montreal, situated far up the rivers, or connected with the sea by canals; for greater security and protection against the hordes of pirates which infested the seas, and continually ravaged, pillaged and burnt the coast towns whenever the opportunity offered.

It was for this same reason, viz., the ease with which the glass could be brought, that all the principal cities in England in which glass-painting was carried on, such as London, York, Bristol, Nottingham, etc. were situated on rivers, or within easy reach of one, moreover all of them were, with the exception of Bristol, on the east coast, and so in close touch with the commerce of the continent. Nottingham, if there was a school of glass-painting there, as is very probable, and York may at first sight look like exceptions to this rule. But in reality they are not so, for York, besides being in close touch with Goole and Hull, had its own little fleet which was continually making voyages across to Veere, and other Flemish ports, and Nottingham, though nowadays looked upon as an inland city, was formerly a port where ships from Hull and other eastern ports came to unload their cargoes at its quays. York obtained its glass through Hull, though some of it might be imported direct, Norwich through Lynn or Yarmouth.

In the middle ages practically the whole of the overseas carrying trade was in the hands of the merchant adventurers, or of the Hanse. The latter, who were first in the field, were a confederation of towns in North Germany and Flanders, bound together with the object of getting the whole of the carrying trade of northern Europe in their their own hands. The head of the confederation was Lubeck. But Bruges became the central market for the whole of Europe this side of the Alps. There congregated Lombard bankers, Florentines, Spanish and Portugese, French, English and north and south Germans, who came to buy the products of the east brought from Venice via the Alpine passes and the Rhine. Meetings of merchants were held at stated times, who came with the products of their respective countries to be changed for those of others. Thus, when the mediæval poet wished to show the folly of riches, he describes the anxiety of the merchant whose servant was at Bruges. " Piers Plowman " Pars. 278-285. The only rivals of the Hanse for the trade of the Baltic were the merchant adventurers, who rose from being a mere collection of free lances, running an uncontrolled and frequently illegal trade, taking any cargo that offered, and snatching business which was often little better than smuggling, into a highly organised and close corporation, which arrogated to themselves the whole trade not controlled by the staple. From one or the other of these importers, the English glass-painter had to buy his glass. The Hanse had warehouses in London, York, Hull, Bristol, Norwich, Ipswich, Yarmouth, Boston and Lynn. The London warehouse, known as the Steelyard, from the fact that all imports were checked and weighed there, was situated in Thames Street on the left bank of the river, close to Dowgate, and just above London Bridge, and through it most of the glass imported from Flanders passed.

Thus, in the St. George's Chapel Windsor acounts for 1351-2, there is an item of a payment of 10d. " for porterage and water transport of the said glass of different colours from Temesestreete to Westminster," and it was no doubt to the warehouse there that John Prudde went in 1447, in order to buy the best . . . . " glasse of beyond the seas that may be had in England " for the windows of the Beauchamp Chapel at Warwick. The York men bought their glass from either the Hanse merchants at Hull or from the merchant adventurers there. Thus in 1536 York Minster paid a certain sum " to William Matthewson of Hull for 22 wisps of coloured Burgundy glass ": and in the same year:—" to the same for 8 wisps of white Burgundy glass." (" York Minster Fabric Rolls." Surtees Soc.).

(To be continued.)

Merchandise Marks and Other Matters.

(By OUR CITY CORRESPONDENT.)

Controversy over Merchandise Marks appears likely to result in a more closely-drawn battle than seemed at one time probable. The Government Bill may not be debated until after Easter. Meanwhile, there is a great deal of activity on the subject behind the scenes. Early in February the President of the Association of British Chambers of Commerce called a national conference on the subject, when the delegates were asked to express the views of their area organisations upon the proposals contained in a Bill which was drafted and circulated by the Association a year or two ago. In a covering letter convening the meeting Mr. Machin stated that " as a result of enquiries " he proposed to assume that the new legislation which the Government has announced its intention of introducing will be on the lines of this Bill. Assuming Mr. Machin's forecast to be correct, the contents of the draft in question assume considerable interest, and on this account I feel justified in setting out its provisions in full. The measure is described as " a Bill to make provision for requiring an indication of origin to be given in the case of certain imported goods " and it reads as follows :—

" Be it enacted by the King's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled and by the authority of the same, as follows :—

Power to require indication of origin in the case of certain imported goods.

" 1. (1) The Board of Trade, if satisfied that it is in the public interest that imported goods of any class or description should not be sold for use or consumption in Great Britain or Northern Ireland without having applied to them an indication of origin, may, after an inquiry has been held under this section and the report thereon of the committee to be appointed for the purposes of this section has been presented to the Board, make an order applying this Act to goods of that class or description.

" (2) An inquiry for the purposes of this section shall be held by a committee which shall consist of three competent and impartial persons to be appointed by the President of the Board and shall have power to take evidence on oath.

" The Committee shall, as soon as may be after the conclusion of the inquiry, make a report to the Board specifying the classes or descriptions of goods (if any) with respect to which in the opinion of the committee an order ought to be made under this section, and, if the committee think it desirable, recommending what should be the form and character of the indication of origin, and in what manner the indication should be applied to the goods.

" The first inquiry for the purposes of this section shall be initiated within six months after the commencement of this Act.

" (3) An order made under this section shall specify—

(a) The form and character of the indication to be given; and

(b) The manner in which the indication is to be applied to the goods; and

(c) The date on which the order is to come into force.

Offences.

" 2. (1) If any person sells, or exposes for sale, in Great Britain or Northern Ireland, any goods of a class or description to which this Act applies, he shall, if the requirements of the order applying this Act to those goods are not complied with in respect of the goods, and subject to the provisions of this section, be guilty of an offence against the Merchandise Marks Act, 1887 (in this Act referred to as the " principal Act ") :

" Provided that—

(i) The provisions of this sub-section shall not apply to the exposure of goods for sale wholesale by a person being a wholesale dealer; and

(ii) In the case of the sale of goods wholesale by a wholesale dealer it shall be a good defence if the person by whom the goods were sold satisfies the court that the goods were sold to the purchaser on an undertaking that they would either be marked in accordance with the requirements of the order or exported or sold for exportation to a place outside Great Britain and Northern Ireland, and a statement in writing to that effect purporting to be signed by the purchaser, and specifying the usual business address of the purchaser, shall be admissible as *prima facie* evidence of the facts appearing in the statement.

" (2) If any person advertises for sale any goods to which this Act applies, he shall, if he does not indicate in the advertisement the origin of the goods, and subject to the provisions of this section, be guilty of an offence against the principal Act.

"(3) Where any person sells or exposes for sale any goods of which any imported goods, being sold to which this Act applies, form a distinguishable part, and that part is reasonably capable of being marked in a manner required by the order applying this Act to those goods, he shall for the purposes of this section be deemed to have sold or exposed for sale that part, and the provisions of this section shall apply accordingly.

" (4) It shall not be lawful to send or submit to any person samples of goods to which this Act applies unless the required indication of origin is applied to the samples or is notified in writing to the person to whom the samples are sent or submitted, and if any person acts in contravention of the provisions of this sub-section he shall be guilty of an offence against the principal Act.

" (5) A person shall not be treated as being guilty of an offence against this Act if he proves—

(a) That having taken all reasonable precautions against committing such an offence he had at the time of the commission of the alleged offence no reason to suspect that the goods were goods to which this Act applied; and

(b) That on demand made by or on behalf of the prosecutor he gave all the information in his power with respect to the persons from whom he obtained the goods; or

(c) That otherwise he had acted innocently.

Laying before Parliament and revocation and variation of orders.

" 3. (1) Before any order is made under this Act, a draft of the order shall be laid before each House of Parliament, and the order shall not be made unless both Houses by Resolution approve the draft, either without modification or addition or with modifications or additions to which both Houses agree, and the Board of Trade may, on the draft being so approved, make the order in the form in which the draft was approved.

" (2) Any order made under this Act may be revoked or varied by a subsequent order made in like manner and subject to like conditions.

Exercise of powers of Board of Trade under Act.

" 4. Anything authorised under this Act, to be done by, to, or before the Board of Trade, may be done by, to or before the President, a Secretary or Assistant Secretary of the Board, or any person authorised in that behalf by the President cf the Board.

Interpretations.

" 5. For the purposes of this Act—

The expression ' imported goods ' does not include imported before the date on which the order applying that Act to the goods comes into force (was made) or goods which since the date of their importation have undergone a substantial change by reason of a manufacturing process applied to them within Great Britain and Northern Ireland.

The expression ' indication of origin ' means either an indication of the country in which the goods were manufactured or produced or such other qualifying statement as may be prescribed in the order by which this Act was applied to the goods and given, in either case, in a conspicuous form.

The expression ' the country in which the goods were manufactured ' means the country in which they last underwent, previous to importation, a substantial change by reason of a manufacturing process:

The expression ' advertise for sale ' does not include the distribution of general trade catalogues or price-lists or the use of advertisements printed or constructed before the date on which the order applying this Act to the goods referred to in the advertisement was made.

Short title.

" 6. This Act may be cited as the Merchandise Marks Act, 192-, and the Merchandise Marks Act, 1887 to 1911, and this Act may be cited together as the Merchandise Marks Act, 1887 to 192-."

It subsequently transpired that at this February conference a decision had been reached in favour of the marking of imported goods where possible, without necessarily indicating the exact country of origin. It was stated that the voting was 26 in favour and 2 against; but there is the further important fact that 13 Chambers abstained from voting, and these included London, Manchester, Bradford, Hull, Bristol, and the National Chamber of Trade. It will be noted that the abstaining Chambers are very influential ones, and this may be taken as affording some indication of the strength of the resistance which is likely to be offered if the Government proceeds along the lines indicated.

A few days afterwards a Board meeting was held at the Manchester Chamber of Commerce, and after prolonged discussion, a resolution was adopted for transmission to the President of the Board of Trade to the effect that " the Board of the Manchester Chamber of Commerce do not approve of legislation for compulsory marking of the foreign origin of imported goods." The Board added that the British manufacturer had only to mark his produce " Made in Britain " to achieve the result aimed at by the suggested legislation without all the disadvantages necessarily attendant on the latter. It was also intimated that the question of marking manufactured goods ought not to be prejudiced by the quite distinct question as to the desirability of compulsory marking of agricultural produce and foodstuffs. (The Government is understood to intend an omnibus Bill which will deal with these two questions at the same time).*

Apropos of the Manchester suggestion that the British manufacturer has his remedy in his own hands if he will only mark his own goods " British Made," special interest attaches to a letter recently issued by Mr. Percy Brooks (of Harrods), the Chairman of the China and Glass Retailers Association of the U.K.

The letter deals with the alleged " piracy " of British patterns by foreign manufacturers. Mr. Brooks suggests that it is a scandal that the foreigner should be allowed to appropriate our best patterns " and brazenly push his wares openly in our markets labelled with a good British name." He would, he said, favour legislation that compels such piracy to adopt foreign nomenclature, since it is feared that customers are often misled in this way, and, of course, it by no means follows that a British name connotes British origin. (Mr. Brooks is quite right in this observation, but the suggestion needs qualifying by the remark that goods are not allowed to come through the Customs barrier with any kind of British wording on them, or with any wording that might even be thought to be British, unless the articles are clearly marked with the name of the actual country of origin.) The rest of the letter is of such importance to the Glass Trade that I give it verbatim:—

> " The imitative process is not confined to the handmade goods; the pressed glass manufacturers suffer also. Quite recently an aspiring student from one of our art schools brought to my notice a very commendable idea for a glass article. I referred it to the works to consider its production. I regret to

---

* Since the above was written and as we go to press, the promised Government Bill has been published and will be explained and discussed in our next issue.—Ed.

have to say that it was reluctantly turned down because, after heavy initial expenditure necessary for moulds, etc., it would inevitably be copied by the alert foreigner and offered at a lower price. Can anyone justify the continuation of this disheartening state of affairs?

" Another instance came to my notice a few days ago. A well-known Stourbridge maker has held the contract for supplying certain hotel glass practically at cost. Often these contracts are so cut that they amount to a loss, and it is a fact that masters accept them in order to keep their hands employed over slack periods. A foreign agent appeared, and offered the customer to supply similar glass on a lower scale. He could afford to do so. The unfortunate Stourbridge maker was thus faced with the alternative of continuing at greater loss or putting the operatives off. This is typical of what is taking place, and we must make no mistake on the point that the pursuance of the existing policy (or lack of it) will compel the closing down of still more of our diminishing works.

" We must also realise that subsidiary trades, e.g., crate makers, glass-house, fireclay, pot makers, etc., are dependent upon the main industry; these must share in the general unemployment and ensuing distress. Let the public insist on British goods; the quality of our productions is its mainstay. Such excellence is registered as to durability, appearance, design, and finish that we have nothing to fear on those grounds. We have everything to fear from unfair foreign competition.

" We have laboratories, societies for research, and technology, etc., for the systematic encouragement and training of young people for employment in an interesting and artistic career. We cannot be surprised that with the present uncertain outlook aspiring students and craftsmen hesitate to commit themselves to such a career.

" I sincerely hope that the authorities will speedily awake to the urgent need for efficient safeguarding, and bring about such legislation as will restore our national industry to the splendid position it once held. I am sure I am voicing the sentiments of my committee in recording my personal appreciation of your action in making this important matter a subject for publicity."

Safeguarding of Industries. Rumours have been going round of a fresh attempt on the part of the combined glass manufacturers in this country to get the Board of Trade to reconsider its rejection of the Safeguarding of Industries application. At the moment it does not seem likely that the attempt will succeed. Ever since the Safeguarding debate in Parliament last December the Department has been noticeably more cautious in its handling of these applications. I know of at least three cases in which the Board has very meticulously criticised the memoranda put forward by manufacturing organisations. This may be irritating to the applicants who feel themselves entitled to tariff protection. At the same time, the Department is no doubt acting in the best interests of the applicants themselves, having regard to the severe sifting which these cases have to undergo at the hands of Committees of Enquiries before they can possibly succeed. If an ill-prepared case is publicly examined it can do the applicants no good, and our manufacturers will be the first to admit that their prestige is likely to be injured if an application after public cross-examination is rejected on its merits. If an industry cannot get its tariff it is always better off if its troubles are not ventilated in public at all. The impression only too easily gets abroad that a certain British industry is claiming to be in a parlous condition.

Meanwhile, as the Budget approaches (it is to be introduced on April 12th) the policy of the Government in regard to the Key Industries Schedule is becoming tolerably clear. The matter will have to be dealt with in the Budget. It was mistakenly thought that the present Key Industries Schedule expires on September 30th. The actual date is August 19th, i.e., five years from the date of the passing of the Safeguarding of Industries Act, 1921. Obviously, therefore, the duties, if they are to be renewed, must be dealt with in the summer Finance Bill. I understand the Government will practically propose to renew the present Schedule for a further period of five years, and they are likely to carry the proposal safely through the House of Commons.

But not without fierce criticism. A public meeting is to be held in the City on April 8th, promoted by the Chemical and Allied Trades affected by the present Schedule. At this meeting it will be claimed that while some of our industries at present protected by Key Industries Duty may have just grounds for claiming continued protection, it should at least be required that they make good their case under the terms of the White Paper of last February as other industries have to do. There are certainly articles included in the present Schedule which have no business to be there. Examples can be given of goods which are subject to duty which, even after five years of the Safeguarding Act, are not manufactured in this country at all. What is the use of penalising their import—especially as they are raw materials to certain other industries?

So far as glassware is concerned, a good deal of propaganda has been carried on in the public Press. Important letters influentially signed by technical experts have been printed in *The Times* and other newspapers supporting the high quality of British productions, especially in optical and scientific glassware. This propaganda will not have been without its effect on Parliamentary opinion, and may assist the safe passage of these particular items in the Schedule when the Budget discussions take place.

Trade Boards. A year or two ago officials at the Ministry of Labour were making close enquiries in the china and glass trade on the subject of wages, with a view to promoting the establishment of a Trade Board to govern rates of pay and conditions of labour. At that time the Trade Board system had not been applied to any of the distributive trades. A commencement was made with a Grocery Trade Board. This has broken down, meaning that the experiment has failed at a first test, and that the present Government has made up its mind not to extend the Trade Board system any further. The inference is that the china and glass trade can get on with its business without fear of this particular kind of Government interference.

January Trade Returns.

IMPORTS OF GLASS AND GLASSWARE.

		QUANTITIES.		VALUE.	
		Month ended 31st January.		Month ended 31st January.	
		1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)	value	—	—	5,244	5,315
Glass Tubing Rod for all purposes	cwts.	831	682	2,557	2,011
Illuminating Glassware	,,	14,158	15,536	40,856	43,932
Machinery Glassware	,,	8	5	157	41
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	45,115	48,241	122,519	128,462
Plate and Sheet Glass	,,	91,842	102,649	143,699	125,710
Optical Glass (other than worked Elements, e.g. Lenses)	,,	8	3	537	89
Bottles and Jars	gross	105,779	111,495	66,659	66,033
Glass and Glassware not elsewhere specified	cwts.	1,325	2,921	4,031	7,577
Total Value	£	—	—	386,259	379,170

EXPORTS OF GLASS AND GLASSWARE (BRITISH PRODUCTS).

		QUANTITIES.		VALUE.	
		Month ended 31st January.		Month ended 31st January.	
		1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)	value	-	—	7,314	6,296
Tubing and Rod for all purposes	cwts.	594	307	3,487	1,839
Illuminating Glassware	,,	461	390	5,251	3,677
Machinery Glassware	,,	354	295	2,103	2,052
Domestic and Fancy (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	2,514	1,993	20,657	18,790
Plate and Sheet	,,	67,828	81,231	144,548	148,363
Optical (other than worked Elements, e.g. Lenses)	,,	16	2	465	30
Bottles and Jars	gross	21,254	18,876	23,271	20,354
Glass and Glassware not elsewhere specified	cwts.	533	813	2,518	5,243
Total Value	£	—	—	209,714	206,644

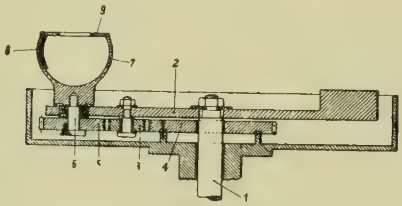
EXPORTS OF GLASS AND GLASSWARE (FOREIGN AND COLONIAL MERCHANDISE).

		QUANTITIES.		VALUE.	
		Month ended 31st January.		Month ended 31st January.	
		1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)	value	—	—	522	301
Glass Tubing and Rod for all purposes	cwts.	1	1	13	19
Illuminating Glassware	,,	228	145	1,420	1,113
Machinery Glassware	,,	—	—	—	—
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	591	585	3,990	3,354
Plate and Sheet Glass	,,	196	700	310	527
Optical Glass (other than worked Elements, e.g. Lenses)	,,	1	3	8	15
Bottles and Jars	gross	2,526	867	2,446	699
Glass and Glassware not elsewhere specified	cwts.	45	8	403	100
Total Value	£	-	—	9,112	6,128

United States Patents.

GRANTED JANUARY 19, 1926.

1,570,242.—**Method of and Means for Working Curved Surfaces.** Paul Goerz, Grunewald, near Berlin, and Ernest Jacobi, Friedenau, near Berlin, Germany, assignors to the firm of Optische Anstalt C. P. Goerz Aktiengesellschaft, Friedenau, near Berlin, Germany. Filed October 4, 1923. Serial No. 666,439. 6 Claims. (Cl. 51—7.)



1. A method of working lenses and like spherically curved articles by means of a grinding cup having a peripheral wall consisting in loosely putting a blank to be worked upon into the grinding cup and subjecting said cup with the blank loosely put therein to rotational motion of such velocity that the blank is centrifugally pressed against the peripheral wall of the cup, the wall having at the same time an advancing motion communicated to it with relation to the point of intersection of the cup wall and the direction of the centrifugal force pressing the blank against said wall.

4. A grinding or polishing device comprising a cup shaped grinding tool adapted to receive in its cavity a work piece or blank to be worked upon, said cup having a peripheral working surface of circular cross section, a carrier for said grinding cup mounted for rotational movement so as to guide the grinding cup along a recurrent path, the cup being so mounted on said carrier and otherwise so engaged that the axis of the working surface of the cup remains at all times at right angles to the rotational plane of the carrier and that the working surface of the cup at the point of intersection with the direction of centrifugal force produced by the rotational movement experiences displacement laterally to said direction of centrifugal force.

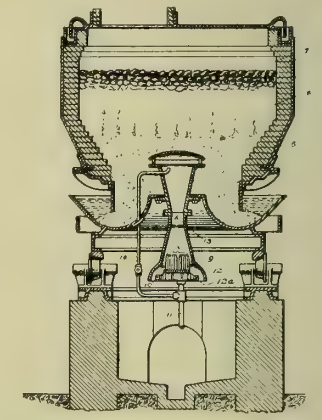
1,570,368.—**Decorating Glass Surfaces.** Charles C. Zeh, North Hackensack, N. J., assignor to Zeh Incorporated, a Corporation of New Jersey. Filed November 3, 1922. Serial No. 598,758. 8 Claims. (Cl. 49—82.)

1. In the art of fixing designs to a transparent glass object, the process which consists in placing a decalcomania of the design on the front side of a sheet of opal glass, causing the rear side of the opal glass to adhere temporarily to the transparent glass object and subjecting the two glasses to a heat treatment to cause the opal glass to adhere by fusion to the glass object.

1,570,353.—**Method of Producing Alumina.** Rudolf Jacobsson, Kagerod, Sweden. Filed August 25, 1924. Serial No. 734,119. 5 Claims. (Cl. 23—142.)

1. Method of producing alumina, comprising vaporising the water of crystallisation from hydrous aluminium sulphate without fusing the salt, and then heating the anhydrous sulphate to such temperature that the sulphuric acid is driven off, the remaining product being alumina of high porosity.

1,570,314.—**Gas Producer.** Sanford A. Moss, Lynn, Mass., assignor to General Electric Company, a Corporation of New York. Filed February 27, 1923. Serial No. 621,656. 6 Claims. (Cl. 48—87.)



1. In a gas producer, in combination, a fuel chamber, air and steam admission means comprising a steam-actuated jet blower for blowing air and steam into the fuel charge, said jet blower having a discharge tube and steam nozzle means, and the area of the throat of the discharge tube being not more than one hundred times greater than the total steam nozzle throat area.

GRANTED JANUARY 26, 1926.

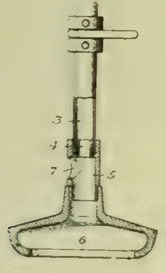
1,570,659.—**Method of and Apparatus for Drying Refractory Materials.** Wiliam E. Wilson, Mason City, Iowa, and Henry G. Lykken, Minneapolis, Minn. Filed December 11, 1923. Serial No. 679,954. 26 Claims. (Cl. 34—46.)

1. A method of drying refractory ware, comprising moving the ware through a heating and humidifying medium, the ware being subjected to increasing temperatures and decreasing humidities during said movement of the ware through said medium, causing a general travel of said medium in a direction opposite to the travel of the ware, and forcing said medium at successive points vertically through said ware.

1,570,822.—**Method and Apparatus for Annealing and Cooling Sheet Glass.** Frederic L. Bishop, Pittsburgh, Pa., assignor to Window Glass Machine Company, Pittsburgh, Pa., a Corporation of New Jersey. Filed September 4, 1924. Serial No. 735,790. 4 Claims. (Cl. 49—47.)

1. In the method of annealing and cooling sheet glass, the steps consisting in passing glass through a leer, passing streams of heated gaseous fluid through the leer above and below the glass and in contact therewith, and varying the cooling effect of at least one of said streams from side to side of the leer.

1,570,695.—**Glass-Drawing Apparatus.** William L. Monro, Pittsburgh, Pa., assignor to Window Glass Machine Company, Pittsburgh, Pa., a Corporation of New Jersey. Filed November 6, 1922. Serial No. 599,236. 4 Claims. (Cl. 49—121.)



1. In apparatus for drawing glass cylinders, a bait, a chamber adjacent the bait, and a nozzle of smaller cross sectional area than the chamber adapted for the discharge of air in jet form through the chamber and into the bait, the chamber having a substantially continuous wall at one side of the path of said air jet and having an opening opposite such wall, substantially as described.

1,570,853.—**Manufacture of Glass Cylinders.** William L. Monro, Pittsburgh, Henry F. Clark, Oakmont, and Lonnie J. Pierce, Pittsburgh, Pa., assignors to Window Glass Machine Company, Pittsburgh, Pa., a Corporation of New Jersey. Filed April 29, 1918. Serial No. 231,332. 12 Claims. (Cl. 49—17.)

4. In apparatus for drawing glass cylinders, a bait, a chamber above the bait through which air is supplied to the cylinder being drawn, having an air inlet opening which is of smaller cross-sectional area than and is adapted to discharge air in jet form into the chamber said chamber being at least partially enclosed laterally of the air steam and having a venting opening, substantially as described.

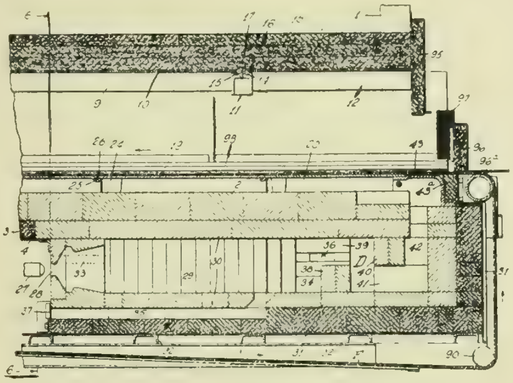
1,570,876.—**Glass and Article Made Therefrom.** Arthur H. Compton, St. Louis, Mo., assignor to Westinghouse Lamp Company, a Corporation of Pennsylvannia. Filed October 16, 1920. Serial No. 417,378. 7 Claims. (Cl. 106—36.1.)

1. A glass resistant to the chemical action of vapors of metals of the sodium group, comprising boron oxide, and basic oxides including at least one alkali metal oxide, at least one of the following oxides, namely, calcium, barium, strontium or magnesium oxide, and aluminium oxide.

1,570,954.—**Regenerative Furnace.** Nicholas F. Egler, Chicago, Ill. Filed June 30, 1923. Serial No. 648,808. 4 Claims. (Cl. 263—15.)

3. In a reversing regenerative open hearth furnace, a central mixing port, an air port on each side of the mixing port, a regenerative chamber communicating with said mixing port, a regenerative chamber communicating with said air ports, a passage leading from each port to its regenerative chamber, a separate passage adjacent each passage leading to the air port, a cross passage connecting the last named passages, and a valve in each cross passage.

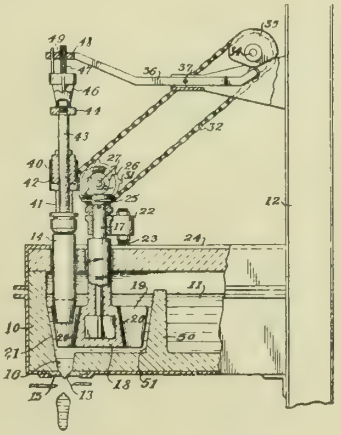
1,571,137.—**Method and Apparatus for Annealing Glassware.** Vergil Mulholland, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed March 31, 1925. Serial No. 19,615. 51 Claims (Cl. 49—46.)



4. The method of annealing glassware, which comprises passing the ware through a tunnel, heating the lower portion of the tunnel to cause upwardly moving convection currents, cooling the upper portion of the tunnel to cause downwardly moving convection currents, and independently regulating both the heating and the cooling of said portions of the tunnel at intervals longitudinally thereof to control the rate of movement of said convection currents.

GRANTED FEBRUARY 2, 1926.

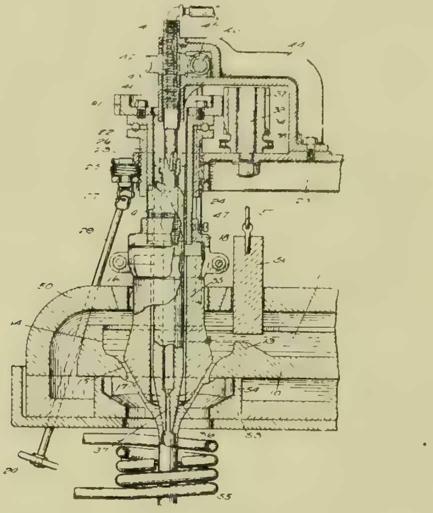
1,571,215.—**Glass Feeder.** Leonard D. Soubier, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Filed August 27, 1923. Serial No. 659,452. 9 Claims. (Cl. 49—55.)



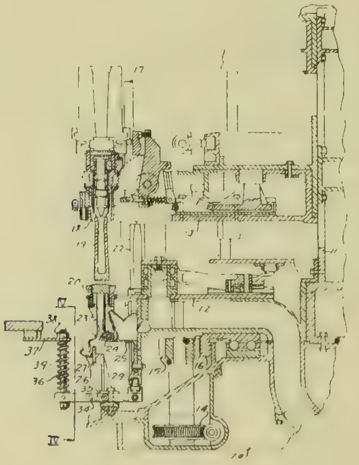
2. The combination of a container for molten glass having an outlet opening in the floor thereof, a vertically reciprocating plunger in line with said opening, and means operable to successively register measured quantities of glass with said outlet opening, said means comprising a horizontally rotatable member having a series of pockets formed therein.

1,571,216.—**Method of and Apparatus for Forming Glass Tubing.** Leonard D. Soubier, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Filed October 4, 1923. Serial No. 666,428. 18 Claims. (Cl. 49—121.)

1. In a tube forming device, the combination of a container for molten glass having an outlet opening in the bottom thereof, a forming device projecting vertically downward into the glass and through said opening, and a blow pipe disposed within said forming device and protruding below the forming device in position to be engaged by the issuing glass and thereby assist in imparting a tubular formation to the glass.



1,571,445.—**Machine for Forming Glass Articles.** Albert N. Cramer, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Filed July 21, 1923. Serial No. 652,922. 10 Claims. (Cl. 49—9.)



1. In a glass blowing machine, the combination of a travelling mold carriage, means thereon to support a bare parison in a depending position, a mold bottom beneath said parison arranged to engage the latter during the travel of the mold carriage, and means separate from the mold carriage and stationary during the travel of the mold carriage for effecting a vertical adjustment of the mold bottom relatively to the parison supporting means.

SILLIMANITE

a neutral refractory material having a definite fusing temperature above 3270°F (1800°C).

The December issue of GLASS reported the following expert opinions expressed in papers or discussion at the Leeds Meeting of the SOCIETY OF GLASS TECHNOLOGY:—

Mr. H. H. Houldsworth (of the Fuel Department, Leeds University).

"Experiments made on commercial sillimanite bricks showed that they exhibit very little permanent change in dimensions on heating, their refractoriness is high, and they offer great resistance to attack by soda-lime-silica glass."

Mr. F. G. Clark (of Messrs. Beatson, Clark & Co., Ltd., Sheffield).

"I can testify to the particular resistance to attack of a mixture of about 66⅔ per cent. sillimanite, from experimental data obtained at my works."

Professor W. E. S. Turner (of the Department of Glass Technology, Sheffield University).

"Glass manufacturers seemed to be more keenly interested in the resistance offered to corrosion by glass, by a refractory material, than its ability to withstand unusually high temperatures."

Mr. W. J. Rees (of the Refractories Department, Sheffield University).

"Sillimanite mixtures containing not less than 60% sillimanite were already justifying themselves for purposes where a highly refractory, resistant material was necessary."

P.B. Sillimanite is now available in the raw state, crushed and graded, and in the form of Bricks, Blocks, Shapes, etc.

The P.B. SILLIMANITE COMPANY, LIMITED,

Sole Agents: PAWLE AND BRELICK

791, SALISBURY HOUSE,
LONDON WALL, LONDON, E.C.2.

Telephone Number - London Wall 4825.

BRITISH PATENTS.

The following abstracts are taken from the Illustrated Official Journal of Patents with the special permission of the Controller of H.M. Stationery Office.

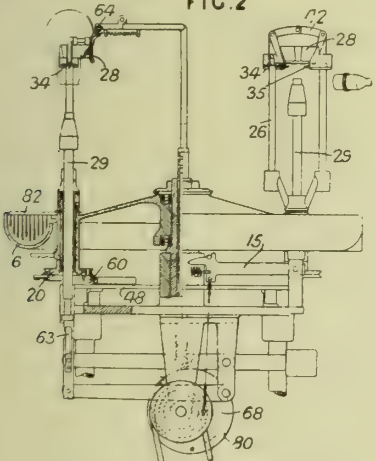
Printed copies of the full specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C., price 1/- each.

242,597.—**Gas-producers.** Soc. Anon. D'Exploitation des Brevets Cousin Dite le Chauffage Industriel, 25, Rue Massena, Lille, France. August 14, 1925, No. 20483. Convention date, November 6, 1924. Not yet accepted. Abridged as open to inspection under Section 91 of the Act. [Class 55 (i).]

The air blast for a producer is moistened by bubbling through water contained in the ashpit. For this purpose, a water tank, with one or more air pipes covered by bells partly submerged, is arranged in the ashpit beneath a distributing cap. The rims of the bells may be perforated or serrated, and the water may be maintained at a constant level. In a modification, a bell is partly submerged in the water-seal of the producer, and arranged beneath a stepped blast nozzle.

242,628.—**Electric incandescent lamps, etc.** Naamlooze Vennootschap Philips' Gloeilampenfabrieken, 6, Emmasingel, Eindhoven, Holland. October 29, 1925, No. 27183. Convention date, November 4, 1924. Not yet accepted. Abridged as open to inspection under Section 91 of the Act. [Classes 39 (i) and 39 (ii).]

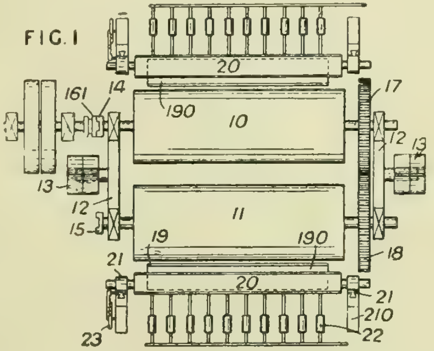
FIG.2



Making lamps; vacuum tubes.—In sealing-in machines having rotatable bulb-holders mounted on a rotary table, the holders comprise a part rigidly fixed in the rotatable head and in which the bulb can rest, and movable chucks adapted to centre the bulb with respect to the stem. In the machine described, each head comprises a hollow stem-holder 29 into which the exhaust tube of the stem is placed, and posts 26 carrying a fixed seating 28 to receive the body of the bulb, and radially slidable chucks 34, 35 having recessed ends to engage the neck of the bulb and thereby centre it. The chucks are normally closed by a spring, but are opened in the discharging and assembling position by means of levers 42 operated by a vertically acting trip-finger 64 carried by a rod resting on a pedal-operated cam 68. A track 48 supports the stem-holder in its raised position, to which it is lifted by a finger 63 actuated by a pedal-operated cam 80. The heads are rotated by a rope passing round pulleys 20 and driven by a motor. A stop 60 arrests the heads in a definite position at the discharging position. The table is held in the several operative positions by a detent 15. Glass refuse falls into a circular gutter 6 and is swept to a discharge opening by a brush 82.

242,703.—**Grinding and polishing glass.** Clark, H. J., Lambkins Farm, Horsmonden, Kent, and Kirby, A., 153, Humber Road, Westcombe Park, Blackheath, London. August 11, 1924. No. 19074. (Class 60.)

FIG.1



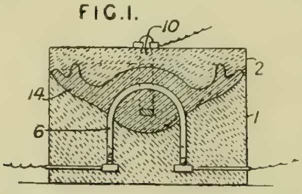
Bevelling; driving and feed devices.—A machine for grinding and polishing bevels on glass plates has a grinding-roller 10 and a polishing-roller 11 mounted in frames 12, which are rotatable on trunnions in frames 13 to bring either roller to operate upon a piece of glass. The rollers are geared together to rotate in opposite directions by gearing 17, 18 and are driven by a clutch member 161 adapted to be engaged with either of clutch members 14, 15 on the driving-shafts of the rollers 10, 11. The glass is mounted upon tables 19, one at each end of the machine, each table being provided with a flange 190 engaging a beam 20, and pressed to move the glass against a roller by hydraulic rams 22. When a bevel has been ground, it is polished by rotation of the frames 12 to bring the polishing-roller into operation. The tables are angularly adjustable on sliders 21 carried by guides 210, and the sliders may be moved upon the guides by levers 23 and links or by a hydraulic cylinder and plunger. The rollers are reciprocated axially by cranks to equalise wear. In a modification, the beam 20 is hollow and water is admitted to it to press the flange 190 of the table. According to the Provisional Specification, one roller only may be provided.

244,391.—**Refractory Substances.** United States Metals Refining Co., Carteret, New Jersey, U.S.A.—(Assignees of Marks, A.; Carteret, New Jersey, U.S.A.). January 21, 1925. No. 1813. Convention date, December 10, 1924. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 22.)

A refractory material, such as calcined magnesite, is mixed with a suitable organic oil, and the mixture is moulded and burned in the usual manner. The oil is preferably a fatty drying or semi-drying oil, such as linseed, cottonseed, fish, or fat-rendering oil. The product is stated to be very compact, having about 22 per cent. of voids, and to have a lower coefficient of expansion than ordinary magnesite refractories.

244,455.—**Insulating Electric Conductors.** Rowland, D. H., 915, Cathedral Street, Baltimore, U.S.A. December 3, 1925. No. 30580. Convention date, December 9, 1924. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Classes 36 and 56.)

FIG. I.



In the manufacture of insulators made of glass and provided with interlinking or other metal suspension elements, the glass is moulded about the suspension elements while they are expanded by heat so that, upon subsequent cooling and shrinking, they will have a loose fit in the body of the insulator. The invention is described as applied to the manufacture of glass insulators 14, Fig. 1, having interlinked suspension members 6, 10. Each of the parts 1, 2 of the mould supports one of the suspension members, which are electrically heated during the process of casting the glass body around them. The suspension members may be shaped so as to be removable.

244,834.—**Glass Manufacture.** McNish, A. and Automatic Bottle Machine Corporation, Ltd., 12, Henrietta Street, London. September 25, 1924. No. 22679. (Class 56.)

FIG. I.

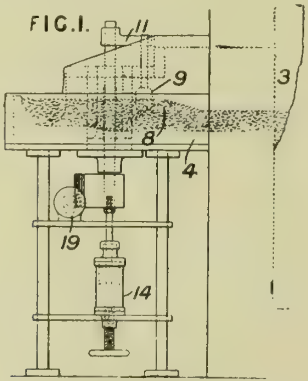
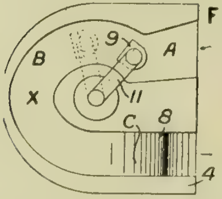


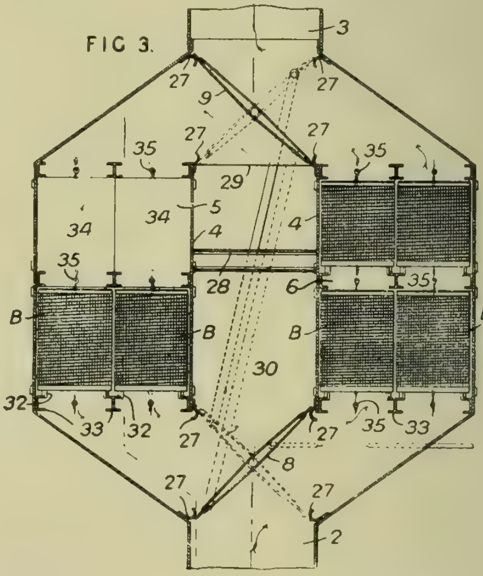
FIG. 2



Delivering molten metal.—A method of conveying molten glass from a tank furnace to a gathering point consists in providing a circuitous channel from the furnace to the gathering point and back again to the furnace, and in causing the glass to flow along this channel by means of an oscillating paddle. The channel is formed in a block 4 of refractory material which forms the floor of a forehearth attached to the furnace 3. The channel, as shown in plan in Fig. 2, comprises a semicircular portion B and two limbs A, C which connect the portion B to the body of the furnace, the limb C being tangential to the semicircular portion B. A weir or wall 8 is formed in the limb C and projects a short distance above the normal level of the glass. The paddle 9 for moving the glass is carried by an arm 11 extending from a central vertical shaft which is reciprocated vertically by an air cylinder 14, Fig. 1, and is oscillated through a semicircle by another cylinder 19. By the combined movement, the paddle is first dipped into the glass, is then moved through 180°, and finally it is raised out of the glass and returned to the dipping point, the movement being repeated at regular intervals. The glass is thus moved along the channel past the gathering point X and over the weir 8 to be returned to the furnace. If desired, the weir may be placed in the channel between the gathering point X and the paddle, and a number of weirs and paddles may be used. The paddle may be arranged to move in a straight line, and the depth to which it is submerged may be varied during the stroke. The weir may also be dispensed with.

244,906.—**Furnaces.** Chamberlain, W. T., 56, West 97th Street, New York, U.S.A. December 9, 1924. No. 29579. (Class 51 (i).)

FIG 3.



Regenerators, reversible.—A chamber having at opposite ends inlet and outlet passages 2, 3 for hot gases, is subdivided into three open-ended compartments of which the two outer contain heat-absorbing material and the central one, divided by a transverse partition 28, opens laterally at one end 29 to the air and at the other end to a lateral flue 30 connected to the grate, etc. The interconnected control valves 8, 9 coact with resilient valve seats 27 and the heat-absorbing elements B are provided with rollers 32 running on tracks 33 for ready removal through doors 34 in the wall of the regenerator for cleaning and replacement. With the valves in the positions shown the air passes downwardly through the chamber 5 to the space below the partition 28 whence it is conveyed by a flue

30 to the grate of the furnace. The smoke passes upwardly from the flue 2 through the chamber 6 and escapes at the flue 3. Steam or air for cleaning the heating elements *in situ* may be injected by nozzles 35.

245,101.—**Refractory Substances.** Deutsche Gasgluhlicht-Auer-Ges., 11, Ehrenbergstrasse, Berlin. December 16, 1925. No. 31799. Convention date, December 24, 1924. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 22.)

Refractory substances containing zirconium oxide, etc.—Zirconium oxide, free from silica and other impurities is mixed with up to 5 per cent. of an alkaline earth oxide, sintered at about 1300° C. and finished by burning at higher temperature to produce a refractory. More porous articles are produced by omitting the sintering stage, and burning the wet-moulded article direct at 1800-2000° C.

245,108.—**Optical-Projection Apparatus.** Marsat, A., Allee du Moulin, Verrieres-le-Buisson, Seine-et-Oise, France. December 18, 1925. No. 32040. Convention date, December 20, 1924. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. Drawings to Specification. (Class 97 (i).)

A transparent body having parallel faces, or of prismatic form, and having an index of refraction different from that of air, is placed between a projection screen and the spectators to produce a relief effect in projected images. The body may comprise a thick plate of glass, a number of thin plates of glass connected together by canada balsam or the like, a vessel containing a liquid or a gas, or a prism formed by a single piece of glass, an assemblage of thin plates, or a vessel containing a liquid or a gas. The prism may produce a single reflection or two reflections, the apparatus being suitably arranged.

245,120.—**Glass Manufacture.** Favre, P.A., 1, Avenue des Peupliers, Crosne, France. December 19, 1925. No. 32099. Convention date, December 19, 1924. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)

FIG.1.

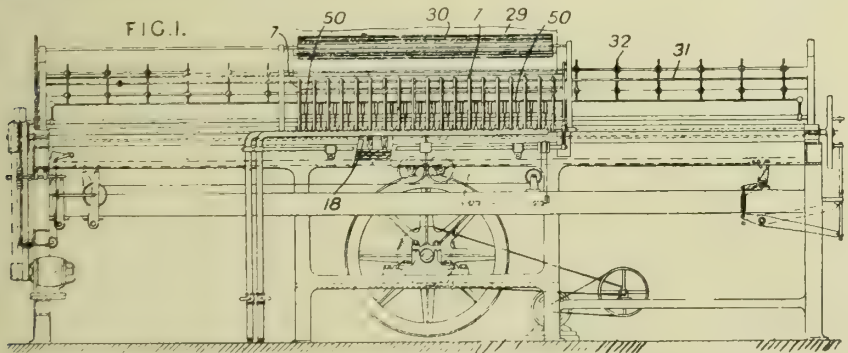
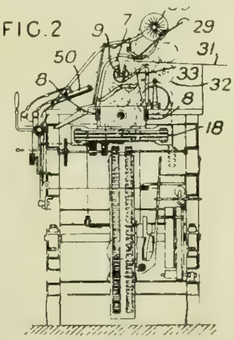
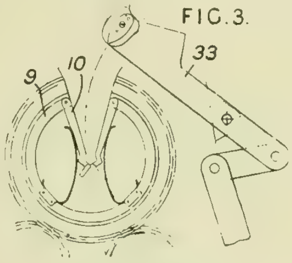


FIG.2



Making articles from tubing.—A machine particularly intended for making serum bulbs comprises means for supporting a glass tube at a number of equidistant points along its length, means for rotating the tube in front of a number of blowpipes, means for stretching the tube to draw out the heated parts, and means for severing the tube at the drawn-out parts in order to divide it into a number of bulbs. The machine, as shown in Figs. 1 and 2, comprises a number of vertical supports 7 which are free to slide on horizontal guides 8 and are connected to a lazytongs 18 so that they can be moved to and from one another. Each support consists of two parallel plates between which a toothed ring 9 is mounted. Both the supporting-plates 7 and the rings 9 are gapped, so that a tube may be carried through the gaps and gripped by spring-operated levers 10, Fig. 3, pivoted on the interior of the rings. A tube thus gripped is coaxial with the rings and is held at a number of separated points. In operation, the rings are rotated and the parts of the tube between the rings are heated by blowpipes 50. When the tube is sufficiently heated, the lazytongs 18 is operated to separate the supports 7, thus drawing out the tube at the heated portions and leaving those portions gripped by the rings of the original diameter. The tubes to be operated on are stored on an inclined platform 29 and are fed to the rings 9 one at a time by a rotary distributor 30. Each tube is received by pivoted levers 33 which carry them into the jaws of the levers 10. After the tube is drawn-out, it is lifted by the levers 33 on to an inclined platform 31 down which it rolls past cutting-wheels 32 that sever it between the bulbs. Modified constructions of the devices for supporting the tubes and from feeding them to, and removing them from, the supports are also described.

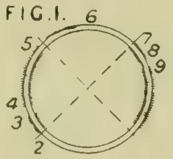
FIG.3.



245,131.—**Glass Manufacture.** Sibor Soc. Anon. Verreries de Romont, Romont, Switzerland. December 21, 1925. No. 32252. Convention date, December 21, 1924. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)

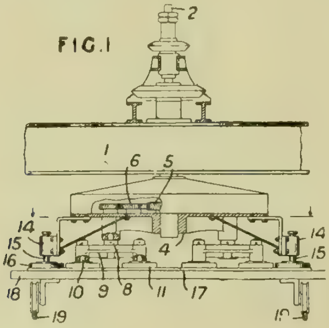
Production of metal.—In the production of a sodium-aluminium borosilicate glass, aluminium sulphate is used as a batch material in order to lower the melting-point. A batch for making glass suitable for high voltage electric insulators consists of 81 parts of sand, 20 parts of crystallised aluminium sulphate, 28 parts of crystallised borax, and 2 parts of crystallised boric acid.

245,297.—**Grinding and Polishing Glass.** Oppermann, F. M., Holisov, near Pilsen, Czecho-Slovakia. February 6, 1925. No 3369. (Class 60.)



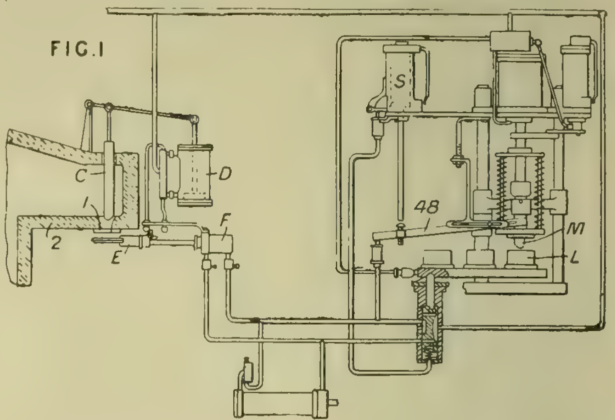
A machine for grinding and polishing glass plates comprises a table, for supporting the glass, in the form of a ring. The table rotates slowly about its centre beneath the grinding, etc., tools; the glass is stripped or laid in the space between 1 and 2, it is ground between 2 and 3, is washed between 3 and 4, polished between 4 and 5, and is stripped and turned over between 5 and 7, the other face then being treated between 7 and 1. In a smaller machine each set of operations on one face corresponds to a complete revolution of the table. The table may be supported on wheels running on rails, or rollers supported in brackets on the ground, or may slide in circular grooves; it is built up as a unitary structure, the parts thereof being inseparably connected together.

245,326.—**Grinding and Polishing Glass, etc.** Carrie, J., Butler, Pennsylvania, U.S.A. April 25, 1925. No. 10785. (Class 60.)



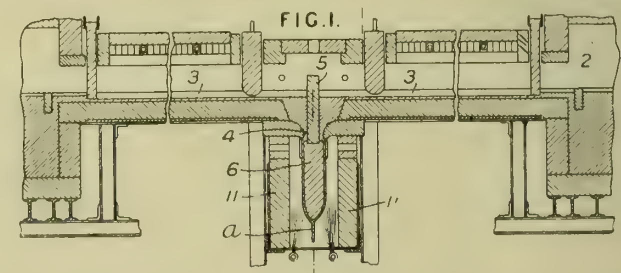
In a machine for grinding or polishing glass &c. plates, the glass &c. 17 is mounted on a table 18 which travels on tracks 19 under the grinding &c. tools, which are carried by a frame 1, auxiliary tools 16 being provided to ensure that the edges of the glass are ground to the same extent as central portions. The frame 1 carries a shaft 2 upon which is a master head 4 having mounted thereon spindles 8, which carry heads 9, and are driven by contact of gears 6 with a central stationary gear 5. The heads 9 carry spindles 10 free to rotate therein, and the spindles carry tools 11. Between the groups of tools 11 the tools 16 are provided, these tools being carried by spindles 15 free to rotate in bearings 14 carried by the master head 4; the tools 16 lie approximately on the outer circle described by the tools 11. In a modification the tools 16 are eccentric with respect to the spindles 15.

245,355.—**Glass Manufacture.** Miller, W. J., Swissvale, Pennsylvania, U.S.A. June 15, 1925. No. 15496. (Class 56.)



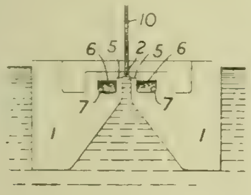
Delivering molten metal.—A method of keeping constant the weights of the charges delivered by an automatic feeder consists in regulating automatically the amount of glass in a charge by the amount of glass in a preceding charge. The metal is fed through a discharge outlet 1 in a forehearth 2 by means of a reciprocating plunger C which is operated by a compressed air cylinder D. The issuing metal is cut into charges by means of shears E operated by a compressed air cylinder F. The charges of metal are conveyed to the moulds L of a forming-machine, and they are pressed either to form the finished ware or to form parisons, as in a press-and-blow machine. The size of a charge of metal issuing from the outlet 1 is regulated by the extent to which the pressing-plunger M descends into the mould L in pressing the charge, that is, the regulation is effected by the amount of glass in the charge which is being pressed. The plunger is connected to a lever 48 and the movement of the plunger causes the lever to operate a timing-valve S. This valve controls the operation of the shears E so that the timing of the shears is controlled by the extent to which the plunger M descends into a mould.

245,362.—**Glass Manufacture.** Marks, E. C. R., 57, Lincoln's Inn Fields, London.—(Danner, E.; 260, Hudson Avenue, Newark, Ohio, U.S.A.) June 30, 1925. No. 16829. (Class 56.)



Drawing; coloured glassware.—A process of forming obscured or tinted sheet glass consists in flowing two or more streams of glass, differing in kind or colour, through a tempering atmosphere in order to bring them to approximately the same temperature, and then causing the streams to unite to form a single sheet. The molten glass flows from tanks 1, 2 through horizontal spouts or forehearths 3 to a common discharge outlet 4 which consists of an elongated slot transverse to the axis of the forehearths. The glasses in the tanks may have different colours or characteristics, and during their flow through the forehearths are brought to approximately the same temperature. A partition wall 5 disposed in the slot 4 separates the glasses, and a directing-slab or member 6 extends downwards from the slab 5. The glasses flow down each side of the slab 6 and unite at its lower edge to form a single sheet *a*. In a modification, an individual directing member is provided for the glass flowing through each of the slots 4, the slabs converging to one another so that the four streams of glass flowing down their sides unite to form a single sheet. In another modification, the slab 6 may extend upwards through the slot 4 in place of the wall 5. A third supply of glass can then be fed on to the top of the slab. In all cases the slab extends downwards into a heating chamber formed by walls 11 to enable the temperature of the flowing glass to be regulated.

245,449.—**Glass Manufacture.** Wessely, E., Bleistadt, near Falkenau-on-Eger, Starrach, N., Felix Dahnstrasse, Karlsbad, and Schmied, F., 2, Roseggerstrasse, Schönau, Teplitz., all in Czecho-Slovakia. December 29, 1925. No. 32794 Convention date, January 3. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)

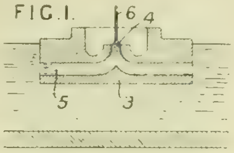


Drawing.—Relates to the method of drawing sheet glass in which the sheet 10 is drawn from a slot 2 in a block 1 of refractory material. According to the invention, the part of the block adjacent to the walls 5 of the drawing-slot is heated in order to prevent chilling of the sheet. The walls 5 of the slot also form the walls of heating-chambers containing solid fuel 6 the combustion of which is assisted by air, liquid fuel or gaseous fuel supplied through perforated pipes 7. By regulating the supply to the pipes 7, the combustion is controlled to obtain the desired temperature of the walls of the slot. The heating may also be effected by electrical means.

245,450.—**Glass Manufacture.** Wessely, E., Bleistadt, near Falkenau-on-Eger; Starrach, N., Felix Dahnstrasse, Karlsbad, and Schmied, F., 2, Roseggerstrasse, Schönau, Teplitz, all in Czecho-Slovakia. December 29, 1925. No. 32795. Convention date, January 3, 1924. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)

Drawing.—Relates to the method of drawing sheet glass in which the sheet 6 is drawn from a slot 4 in a block 3 of refractory material. According to the invention, the metal flowing into the slot is taken from the upper part of the metal in the drawing-pot by connecting the slot with channels 5 formed in the side walls of the block. The channels may be horizontal, as shown, or their outer ends may be upturned, so that metal is taken from near the surface of the metal in the pot.

FIG. I.



245,461.—**Furnaces; Gas-Producers, etc.** Szikla, G., 52, Budafoki ut, Budapest. February 4, 1925. No. 33017. Convention date, February 4, 1924. Addition to 228,906. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. Drawings to Specification. (Classes 51 (i), 55 (i), and 55 (ii).)

Apparatus for the combustion, gasification or degasification of pulverulent solid or atomized fluid fuels held in a state of suspension by a gas current ascending in a vertical shaft flaring upwardly is provided with a grate arranged below the lower end of the shaft for receiving fuel particles. The invention is described in connection with apparatus similar to that described in the parent Specification.

Latest British Patents.

Applications for Patents.

No. 2187.—January 25, 1926. Aktieselskabet Dansk Pressefabrik. Machines for manufacturing crown corks, etc.

No. 2231.—January 26, 1926. E. Shrubsole. Bottle necks.

No. 2287.—January 26, 1926. E. G. Appleby, G. H. Bentley. Gas-Producers, etc.

No. 2395.—January 27, 1926. (Germany October 5, 1925). Holstein and Kappert Machinenfabrik Phönix Ges. Delivery tables for machines for treating bottles, etc.

No. 2410.—January 27, 1926. E. L. Oglethorpe. Bottle crates.

No. 2425.—January 27, 1926. H. A. Easton. Dairy bottle, etc. opener.

No. 2537.—January 28, 1926. J. S. St. B. Baker. Bottles.

No. 2563.—January 28, 1926. (Germany, November 28, 1925). Hallesche Pfannerschaft. Akt. Ges. Apparatus for manufacturing glass vessels.

No. 2568.—January 28, 1926. S. J. Sellar. Machines for manufacturing hollow glassware.

No. 2636.—January 29, 1926. F. Umpleby. Gas generators.

No. 2723.—January 30, 1926. Dawson Bros., Ltd., D. H. Dawson, G. Dawson. Washing, sterilising etc. of screw stoppers for bottles.

No. 3081.—February 3, 1926. A. H. Wilkes. Gas and air injector for gas furnaces, etc.

No. 3155.—February 3, 1926. United Glass Bottle Manufacturers Co., Ltd. Conveyors.

No. 3292.—February 4, 1926. (France, February 7, 1925). G. Le Roy, Stained glass.

No. 3330.—February 5, 1926. T. Thomson. Utilisation of waste heat gases in waste-heat boilers.

No. 3336.—February 5, 1926. J. B. Sanders. Non-refillable bottles.

No. 3351.—February 5, 1926. Dairy Supply Co., Ltd. Boxes for transportation of bottles.

No. 3365.—February 5, 1926. G. Keith, J. Keith and Blackman Co., Ltd. Art of firing gas furnaces.

No. 3383.—February 5, 1926. (France, April 10, 1925). Soc. Anon. des Manufactures des Glaces et Produits Chimiques de St. Gobain, Chauny, et Cirey. Fining glass.

No. 3401.—February 5, 1926. P. M. Salerni. Grinding or abrading machines.

No. 3483.—February 6, 1926. (France, April 11, 1925). Soc. Anon des Manufactures des Glaces et Produits Chimiques de St. Gobain, Chauny, et Cirey. Manufacture of reinforced glass.

No. 3549.—February 8, 1926. P. W. Beard. Optical lantern.

No. 3767.—February 10, 1926. C. McDowall. Stopper for bottles, etc.

No. 3814.—February 10, 1926. P. H. Head. Reinforced glass.

No. 3835.—February 10, 1926. (France, February 11, 1925). A. Winkler. Gas-producers.

No. 3883.—February 10, 1926. A. J. Jonsson. Machines for making and applying caps for bottles, etc.

No. 4021.—February 12, 1926. J. T. Butler. Method of applying designs on pottery, glass, etc.

No. 4129.—February 13, 1926. R. J. Scott. Milk bottle and stopper.

No. 4168.—February 13, 1926. E. Pause. Closures for preserve containers.

No. 4210.—February 13, 1926. C. A. Dellamonica. Grinding etc. tools for glass.

No. 4276.—February 15, 1926. A Sidler. Manufacture of glass.

No. 4311.—February 15, 1926. (Hungary, February 14, 1925). S. Elek. Optical distance meters.

No. 4471.—February 16, 1926. Pittsburgh Plate Glass Co. A. E. White. Making sheet glass.

No. 4956.—February 20, 1926. (Germany, February 23, 1925). A. Trippensee. Refractory materials for furnaces, etc.

No. 4601.—February 17, 1926. F. R. Lang. Manufacture of glassware.

No. 4661.—February 18, 1926. A. E. Hailwood. Manufacture of glass articles.

No. 4723.—February 18, 1926. J. S. St. Baker. Bottles.

No. 4728.—February 18, 1926. G. Kent, Ltd. Manufacture of decorative glass sheets, etc.

No. 4729.—February 18, 1926. G. Kent Ltd. Manufacture of glass for ceilings, etc.

Specifications Published.

234791.—May 31, 1924. Askania Werke Akt. Ges Vorm. Central Werkstatt-Dessau und C. Bamberg Friedenau.

236151. June 24, 1924. Allgemeine Vergasungs-Ces. Process of distillation of bituminous coal in several stages.

238896.—August 23, 1924. K. Noda. Devices for cutting out elliptical glass plates.

242228.—November 3, 1924. M. Fleischer. Thermometers.

246594.—November 3, 1924. B. R. Hoge (legal representative of H. Hoge (deceased).) Sealing wires into glass.

246923.—November 6, 1924. R. W. Edmonds and Webb's Crystal Glass Co., Ltd. Loud speakers for use with wireless receiving sets.

246982.—January 7, 1925. W. A. Burns, J. B. Pearman and K. F. M. Engineering Co., Ltd. Glass signs.

247093.—August 8, 1925. A. W. Brown. Boxes or cases for carrying bottles, jars and the like.

247489.—September 23, 1925. F. W. Golby (Libbey Owens Sheet Glass Co.) Apparatus for drawing sheet glass.

Specifications open to Public Inspection.

246451.—January 22, 1925. C. Zeiss (firm of). Polishing tools for working glass, and methods of making same.

246459.—January 20, 1925. Humphreys and Glasgow, Ltd. Generation and distribution of gas.

246480.—January 23, 1925. Deutsche Gasglublicht-Auerges. Manufacture of refractory articles of pure oxide of zirconium.

247184.—February 4, 1925. Soc. Anon. Francaise Holophane. Prismatic glasses of automobile head-lights.

247206.—February 7, 1925. G. Le Roy. Stained glass.

247552.—February 10, 1925. E. Maingonnat. Closing means for jars, bottles and the like.

247565.—February 11, 1925. A. Winkler. Gas-producers.

247571.—February 11, 1925.—L. Chavanne. Process and apparatus for the gasification of solid fuels.

247606.—February 14, 1925. S. Elek. Optical distance meters.

Patents, Trade Marks, Inventions.—Advice, Handbook and Consultations free. King's Patent Agency Ltd., Director B. T. King, C.I.M.E., Regd. Patent Agent, G.B., U.S., and Canada, 146a, Queen Victoria Street, E.C.4, and 6, Quality Court (next Patent Office), London, W.C. 39 years' references. 'Phone: Cent. 682.

"Improvements in the Manufacture of Glass." The owners of British Patent No. 13734/1911 desire to dispose of the same or would enter into working arrangements with a firm likely to be interested. Particulars may be obtained from Technical Records Limited, of 59-60, Lincoln's Inn Fields, London, W.C.2.

"Improvements in or Relating to Means for Making Glassware." The owners of British Patent No. 161454 desire to dispose of the same or would enter into working arrangements with a firm likely to be interested. Particulars may be obtained from Technical Records Limited, of 59-60, Lincoln's Inn Fields, London, W.C.2.

"Method of Separating Quantities of Molten Glass or Like Material from Mass." The owners of British Patent No. 105564 desire to dispose of the same or would grant a licence to work the Invention on royalty terms. Particulars may be obtained from Technical Records Limited, of 59-60, Lincoln's Inn Fields, London, W.C.2.

"Method and Apparatus for Forming Sheet Glass." The owners of British Patent No. 159114 desire to dispose of the same or would enter into working arrangements with a firm likely to be interested. Particulars may be obtained from Technical Records Limited, of 59-60, Lincoln's Inn Fields, London, W.C.2.

"Improved Method of Obtaining Viscous Charges of Glass from a Viscous Mass Thereof." The owners of British Patent No. 148848 desire to dispose of the same or would grant a licence to work the Invention on royalty terms. Particulars may be obtained from Technical Records Limited, of 59-60, Lincoln's Inn Fields, London, W.C.2.

SITUATION WANTED.

Glass Works Manager with practical experience in all kinds of glass and furnaces, also automatic machines and feeders. Good metal maker for all purposes. Highest references, energetic and reliable.—Box 303, Glass Publications Ltd., Talbot House, Arundel Street, Strand, London, W.C.2.

WANTED.

Advertiser is desirous of purchasing several Lynch machines type L.A. Must be good condition. Reply giving machine numbers, date of installation and where they may be inspected, to Box No. 304, Glass Publications Ltd., Talbot House, Arundel Street, Strand, London, W.C.2.

Prevailing Prices.

Arsenic (Continental or Japanese)	£16	0	0	ton
Arsenic (Refined white powdered)	£15	0	0	ton
Cobalt (Black Oxide)	*£0	8	0	lb.
Cobalt (Grey Oxide)	*£0	8	10	lb.
Cryolite (Synthetic) 99/100%	†£37	0	0	ton
Manganese Peroxide 85/87%	*£19	0	0	ton
Potash (Hydrated Carbonate) 83/85% ..	†£22	10	0	ton
Potassium Nitrate	*£24	0	0	ton
Red Lead, Finest English Manufacturing Glass Makers' quality	*£2	7	0	cwt.
Selenium (Black powdered) 99/100% ..	*£0	8	0	lb.
Soda Ash (Heavy)	£6	5	0	ton
Soda Ash (Light)	£5	17	6	ton
Sodium Nitrate (Refined Chilean) 96% ..	£13	7	6	ton
Sodium Nitrate (Synthetic) 96%	†£13	10	0	ton
Sodium Selenite	*£0	5	6	lb.
Sodium Silico Fluoride	*£17	0	0	ton

The above prices are for usual commercial quantities.

* d/d. Works.

† c.i.f. U.K. port.

GLASS
THE RECOGNIZED ORGAN OF THE GLASS INDUSTRY
Published on the Tenth of Each Month.

Single Copies - - - - One Shilling
Annual Subscription - - 10/6 post free

GLASS PUBLICATIONS Ltd.
TECHNICAL PUBLISHERS,
Talbot House,
Arundel Street,
Telephone: Central 5985. Strand, London, W.C.2.

CONTENTS.

PAGE
Editorial Notes 175
Practical Notes on the Thermal Endurance of Glass.—By H. V. E. Renn 176
Coloured Glass and Glass Decoration.—By James H. Gardiner, F.Inst.P. 180
American Ceramic Society 182
Relative Value of Carbon Monoxide and Hydrogen as Constituents of Producer Gas.—By William E. Rice 183
The Society of Glass Technology 191, 206
Trade Notes 195
The Use of Compressed Air.—By Robert Wilson 199
Publications Received 200
The Source of the Coloured Glass Used in Mediæval Stained Glass Windows.—By John A. Knowles ... 201
The New Government Bill: Glassware to be Branded? —By Our City Correspondent 204
February Trade Returns 207
United States Patents 208
British Patents 214
Latest British Patents 215

Editorial Notes.

During recent months "economy" has become one of the most overworked words in the vocabulary of politicians and business men alike, who would appear to have adopted it as a "catch word" much after the manner of music hall artists. In far too many cases, however, when the business man comes to apply the advice to his own affairs it will be found that he misinterprets the word to mean "cutting down of expenses," so that very often the ultimate idea of economy is defeated.

Webster defines the world as "management without loss or waste," so that in its true meaning, economy should be the fundamental basis of all business organisations and not merely a feature to be adopted at periods such as the present.

There is one particular class of equipment which is usually the first to fall victim in the cutting down expenses war, i.e., instruments, and this no doubt can be traced to the prevailing idea that they are luxuries, whereas, as a matter of fact, they are necessities and should be regarded as such.

In order that it may be possible to determine whether any plant or process is being operated or conducted as economically as possible, it is necessary to make comparisons between what was done under certain conditions and what is done to attain the same end under other conditions. To achieve this, careful measurements and records are required which can only be obtained by the selection and proper use of apparatus which is usually grouped under the general heading of "control instruments."

Since 1915 there has been a remarkable advance in the application of science to the glass industry—in all probability this advance being proportionately greater than in any other industry—yet although the basis of science is measurement, in how many works does one find measuring instruments in general use?

A few years ago pyrometers were regarded by glass manufacturers with the greatest scepticism but at the present time they are to be found in practically every works and are now definitely installed as an absolute necessity. In a similar manner, a trial of numerous other instruments available would quickly show the capable works manager that the information they afford him as to what is actually taking place in the works under his control, is such that, in the majority of cases, alterations and changes can be made which enable real economy to be obtained.

An examination of the control instruments in the boiler house of a modern electric power house would come as a surprise to the majority of glass men, yet the men responsible for their installation are neither scientific cranks nor possessed of philanthropic feelings towards instrument makers. On the contrary they are keenly aware of the fact that the purchase *and use* of equipment of this nature is an absolute essential and moreover is one which probably pays a higher dividend than any other equipment in the plant.

What factory manager who obtains his supply of gas and electric power from an outside source would be content to have the supply in his works without a meter, paying whatever the outside company thought fit to charge? Yet this is the internal state of affairs which actually exists in very many factories.

Efficiency and economy are practically synonymous terms and both are dependent upon figures and data only obtainable by the employment of trained men provided with the necessary equipment.

This being so, it is therefore not only possible but probable that by spending a little time and money on the selection, installation and use of suitable control instruments, the majority of glass manufacturers would be able to effect greater real economies than is possible by any other means.

[Glass *will deal with all matters pertaining to the industry in an impartial manner, consequently the Editor does not necessarily associate himself with the opinions expressed by his contributors.*]

Practical Notes on the Thermal Endurance of Glass.

By H. V. E. RENN.

In a previous article,* the subject of thermal endurance was considered from the point of view of thermal expansion. It was stated that the greater the expansion of a glass the less are its powers of withstanding inequality of temperature, the liability to fracture thereby being increased. That expansion, however, is not by any means the only effective factor in thermal endurance is a matter that is quite readily demonstrated. The thermal conductivity, tensile and compression strength and elasticity are no less important in their influence than expansion. If the thermal endurance of a glass depended largely upon expansion, there would exist some simple relationship between the two that would easily be discernible upon an examination of a series of glasses. A value of the thermal endurance of a glass can be determined experimentally, so that the relationship can easily be examined.

Winkelmann and Schott were among the earliest to investigate the power of glasses to withstand sudden changes of temperature. They devised a practical test which they applied to 13 different glasses of diverse composition. Polished cubes of 1 cm. edge, of the different glasses were placed in water which was heated to a definite temperature. They were then suddenly plunged into cold water, and the operation continued in order to determine the highest temperature that the cubes were able to stand without showing signs of cracking. Glycerine was used when temperatures above 100° C. were found necessary. The results obtained by Winkelmann and Schott are given in Table 1, the temperatures being those at which cracking occurred.

The numbers in the first column are those found in Winkelmann and Schott's list of 72 glasses.

TABLE 1.

Glass No.	Coefficient of Expnsn.	Thermal Endrnce.	Order by	
			Expnsn.	Endrnce.
21	163×10^{-7}	148.0° C.	1	1
19	164 ,,	—	2	3
23	169 ,,	90.5	3	7
34	169 ,,	148.0	4	2
22	205 ,,	103.5	5	4
31	239 ,,	50.5	6	13
33	243 ,,	87.0	7	10
20	243 ,,	61.9	8	12
26	245 ,,	88.5	9	8
24	250 ,,	98.5	10	6
25	251 ,,	103.5	11	5
28	289 ,,	88.4	12	9
27	334 ,,	62.7	13	11

No value is given in the above table for the thermal endurance of Glass No. 19, but from other tests it would seem that this glass is entitled to third place in the order by endurance.

If thermal endurance were a linear function of thermal expansion, then, in the series of glasses tested the results would present a more or less accurate means of estimating their respective expansions. How far this is from being the case can be judged by the table, in which the calculated values for expansion are given for purposes of comparison.

The method devised by Winkelmann and Schott for the determination of the thermal endurance of a glass does not seem at all decisive, since the resistance of the glass, judged by the number of cracks appearing after the test, was found to be considerably diminished by slight defects in the surface.

In the above test, the endurance was established on the basis of cooling, but the investigators also examined the liability to fracture of a glass subjected to sudden heating. If the temperature of a mass of glass is suddenly raised from that of the atmosphere to a much higher temperature, the outer layers are thrown into a state of compression while a tensile stress is set up in the inner layers. The difference of temperature which the glass is able to stand in this case will be much greater than that able to be withstood when the glass is subjected to sudden cooling, for the stress at the surface is in both cases far more intense than the opposite stress of the inner portion; and the compression strength is far greater than the tensile strength. Winkelmann and Schott demonstrated this by a striking experiment.*

Glass No. 20 of the following composition, SiO_2, 20 per cent. and PbO, 80 per cent., which is placed last but one in order by endurance in Table 1, was tested by immersion in melted tin. A cube of 2 cm. edge, which showed signs of cracking when first heated to 52.8° C. and then plunged into cold water, was able to withstand a sudden elevation of 465° without fracture when immersed in the molten metal.

The official test used at the Bureau of Standards, Washington, to determine the thermal endurance, much more resembles the conditions likely to be encountered in practise. It consists in plunging into ice water a vessel containing some suitable liquid previously raised to a known temperature. If the vessel withstands the test, a higher temperature may be applied, and so on until the vessel fractures. The temperature at which fracture just occurs is usually referred to as the "fracture range" of a glass. With some chemical glasses and heat-resisting glasses, the "fracture range" is often as high as 200° or even 250°, but 60° is reckoned a suitable range for ordinary bottle glass. Other factors, of course, influence the

---

* "Glass," March, 1926.

* Ann. d. Phys. u. Chem., 5, 745.

" fracture range " such as the uniformity of thickness and state of annealing. The state of annealing has both a direct and indirect influence. A case of the latter is given in the following account.

The stress left in a glass due to bad annealing has been shown by Schott to be responsible for an increase in the expansion. In determinations upon the coefficient of expansion, a difference was found between the results obtained by using thin-walled vessels and those observed with solid rods of the same glass, the difference being attributed by Schott to the presence of greater stresses in the latter. The rod, 20 mm. in diameter, was cut from a length drawn in the plastic state and allowed to cool in air. The following is an account of the behaviour of the rod as observed by Pulfrich and quoted by Schott.

" Its ends were originally ground perfectly flat, but, after the rod had been kept for some time at 96° C. were found to be distinctly concave, showing that the thermal expansion parallel to the axis increased from the axis to the circumference. Measurements made at different distances from the axis gave :

Distance.	$3a \times 10^7$
0 mm.	277
7.5 mm.	302
10.0 mm.	327

" When the rod had cooled down, the ends were still concave. After being again ground flat, they remained flat after three hours' immersion in boiling water ; and a determination made in the usual way gave $3a \times 10^7 = 289$.

" The rod, with its ends still plane, being then immersed in oil at 200° C., again showed concavity at the ends. The concavity was sensible after five minutes, and after an hour became constant. Similar results were obtained with other glass rods."

The above experiment clearly demonstrates that a deformation is possible with some glasses at temperatures below the softening point. The composition of the glass referred to above is : SiO_2, 68.1 per cent. ; B_2O_3, 3.5 per cent. ; ZnO, 7.0 per cent. ; Na_2O, 5 per cent. and K_2O, 16 per cent. A glass that exhibited no signs of the phenomenon, although in a highly-stressed condition, had the following composition, SiO_2, 51.3 per cent. ; B_2O_3, 14 per cent. ; ZnO, 5 per cent. ; Al_2O_3, 4.5 per cent. and BaO, 25 per cent. The " after-working " of the first glass may possibly be accounted for by the alkali content which shows the total of 21 per cent., whereas the second glass contains no alkalies. It is certain, at any rate, that alkalies have the effect of both increasing the expansibility of a glass and decreasing its conductivity. This is especially true with K_2O.

The effect of strain in the vessels tested by the Bureau of Standards is shown by the following data. The percentage of vessels fractured showing no signs of strain was 9, while 66 per cent. showed slight strain, 14 per cent. medium strain and 11 per cent. strong strain

It may be mentioned that the " fracture range " determination furnishes what is perhaps the only method of ascetraining the state of annealing with glass that is opaque or that for some other reason cannot be examined under the polariscope.

One of the tests conducted at the Bureau of Standards to determine the thermal endurance is described as follows. A vessel containing 200 ml. of melted paraffin is heated on a hot-plate until a thermometer in the paraffin indicates a temperature of about 215° C., then removed from the plate and the paraffin stirred with the thermometer until the temperature falls to 200° C. The vessel is then plunged into ice water.

This test was one of four applied to vessels of various makes and, it may be mentioned, was the one responsible for the greatest percentage of breakages. The results of the tests are given in Table 2, the figures under thermal endurance being the breakages occuring in the four tests expressed as a percentage of the number of vessels tested, while the values for expansion are as determined at the Bureau of Standards, the Fizeau-Pulfrich interference method being used for the temperature interval 10° to 55° C.

TABLE 2.

Glass.	Co-efficient of Expansion.	Thermal Endurance.	Order by Expansion.	Order by Endurance.
Pyrex ..	$100 \cdot 10^{-7}$	10 per cent.	1	1
Jena ..	144 ,,	30 ,,	2	4
Libbey ..	152 ,,	17 ,,	3	2
Fry	170 ,,	42 ,,	4	6
M.E.G. Co...	180 ,,	40 ,,	5	5
Nonsol ..	192 ,,	20 ,,	6	3
Kavalier ..	228 ,,	50 ,,	7	7

It is apparent from an examination of Tables 1 and 2, that there exists no direct relationship between expansion and endurance and that other factors, no less important than expansion, must have a decided influence.

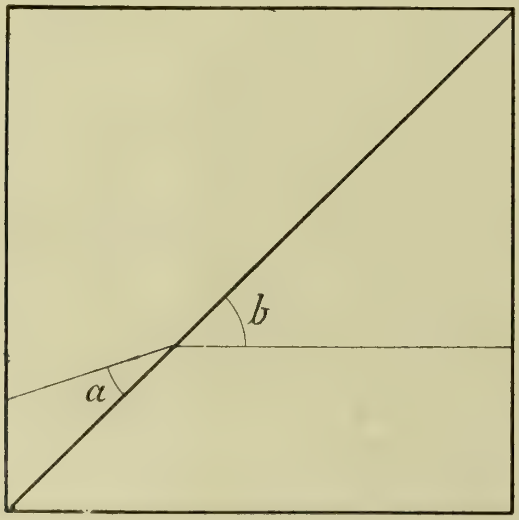
THERMAL CONDUCTIVITY.—A conception of thermal conductivity may be obtained by considering a piece of thin plate glass, one face of which is maintained at a definite temperature and the other at a temperature slightly lower. When the quantity of heat passing into the glass through one face equals that flowing out from the other, no heat being absorbed or otherwise lost during the passage from one face to another, it can be shown that the amount of heat thus passing is proportional to the difference in temperature between the faces, the amount varying directly as the time, and as the area of the plate and inversely as its thickness. It is apparent that if heat were conducted rapidly from one surface of glass to another it would not be possible to set up a difference of temperature sufficient to cause fracture, for the expansion resulting from a uniform increase of temperature throughout the mass of the glass would also occur uniformly and the tensile stress produced would be proportionately small. Glass, although not strictly a poor conductor (a poor conductor is generally reckoned as falling between 0.00008—0.0003 C.G.S. units), does not conduct heat at anything like the rate necessary for these ideal conditions. Hence the desirability for keeping the coefficient of thermal conductivity as high as conditions allow.

The thermal conductivity of a material is usually determined by measuring the rate of heat per unit area and the fall of temperature per unit thickness, the relation being:

$$\text{Conductivity} = \frac{\text{flux of heat}}{\text{temp. gradient.}}$$

The unit in terms of which the conductivity is invariably quoted is defined as the number of calories per second that would flow through every square centimetre of the surface of a wall of 1 cm. in thickness and with a temperature difference of 1° C. between its faces.

There are several methods for experimentally determining the conductivity of a material, but almost without exception elaborate apparatus is required. Perhaps the only method that can be recommended for laboratory tests is the Isothermal Method of Voigt, which is both simple and substantially accurate. A standard glass is necessary for the experiment, the absolute conductivity of which is already known for purposes of comparison. Briefly the method is as follows. Two plates are cut, one from the standard glass and the other from the sample to be tested, in the form of right angle isosoles triangles so that when they are cemented together along their hypotenuses they compose a square of area about four square cm. The plates are thinly coated with shellac and afterwards by a mixture of elaidic acid, wax and turpentine. Elaidic acid melts at about 45°, and in solidifying is deposited in crystalline form, the size of the crystals depending upon the rate of cooling. As soon as the plate is coated it is cooled quickly on a metal stand in order that the crystals formed will be small. When the plate is cool, one edge is brought into contact with a block of copper at a temperature of about 70° C. The elaidic acid mixture is allowed to melt until it has advanced about 4 mm., when the plate is removed from the copper and allowed to cool slowly. The slow cooling results in the formation of larger crystals, so that the difference between the melted and unmelted portions is clearly discernible.



The calculation of the conductivity value is contained in the following example. Assume the angles formed by the lines of melting with the diagonal to be *a* and *b*, as shown in the diagram.

The flow of heat being from the better conductor (right) to the worse. Then it can be shown that the ratio of the conductivities is represented by the general formula:

$$\frac{K_1}{K_2} = \frac{\tan b}{\tan a}$$

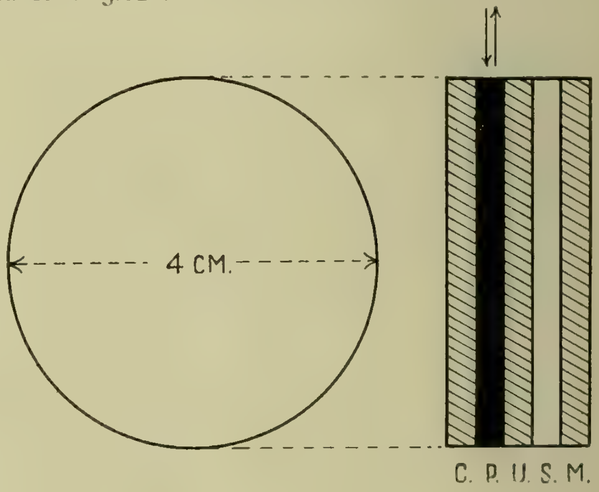
If the angles *a* and *b* were found upon measurement to be 35.6° and 46.3° respectively, then

$$\frac{K_1}{K_2} = \frac{\tan 46.3^\circ}{\tan 35.6^\circ} = 1.4616$$

The ratio is thus 1.4616 : 1, and if the conductivity of the standard glass is known to be 0.002245, then the conductivity of the glass under examination is:

$$\frac{0.002245}{1.4616} = 0.001536$$

Another method for the determination of thermal conductivity is that of Lees* which will be briefly outlined. A small hot-plate is formed of two copper discs *C* and *U* (diagram 2) about 4 cm. diameter, between which is placed a flat heating coil of platinoid wire, *P*, well insulated by mica and shellac. The thickness of the coil with the insulation in Lees's determination was 1.1 mm., the thickness of *C* 1.03 mm., and of *U* 3.12 mm.



S is the substance whose conductivity is to be measured, while *M* is another copper disc 3.2 mm. in thickness. The contacts between the surfaces of the copper discs *U* and *M*, and the substance under examination can be improved by smearing them with glycerine and sliding them together. At the opposite extremities of the diameter of each disc are soldered a copper and platinoid wire which form a thermo-junction for measuring the temperature. The surfaces of the discs are varnished to give them the same emissivity and the device placed in a double-walled air bath. The wires from the heating coil *P* are passed to the cells supplying the heating current, the power absorbed being regulated by a rheostat and measured by a wattmeter.

---

* Phil. Trans. Roy. Soc. Vol. 191, p. 499.

Lees worked out the equations and also the small correction necessary to allow for heat lost along the thermo-couple wires and the leads to the coil. Determinations were made of the conductivity and the variation of conductivity with temperature of pieces of ordinary 22 oz. window-glass. The results obtained were 0.00248 at 35° C. and 0.00272 at 79° C.

The conductivity of this glass is high, for with a series of 25 glasses examined by Focke*, the results varied from 0.001595 to 0.002591. The good conductivity of the sample examined by Lees may possibly be accounted for by high lime content. The lime content of most window glasses is about 14 per cent., while the conductivity coefficient for lime ascribed by Paalhorn (see below) is considerably higher than the coefficients for the other oxides.

To avoid experimental determinations, Paalhorn proposed to express the absolute conductivity of a glass as a linear function of the percentage of its constituent oxides. He adopted a set of coefficients for this purpose which, however, was afterwards slightly modified by Winkelmann. The modified set of factors is given below.

SiO_2	...	0.0000220	Al_2O_3	...	0.0000220
B_2O_3	...	150	BaO	...	100
ZnO	...	100	Na_2O	...	160
PbO	...	80	K_2O	...	10
MgO	...	84	CaO	...	320

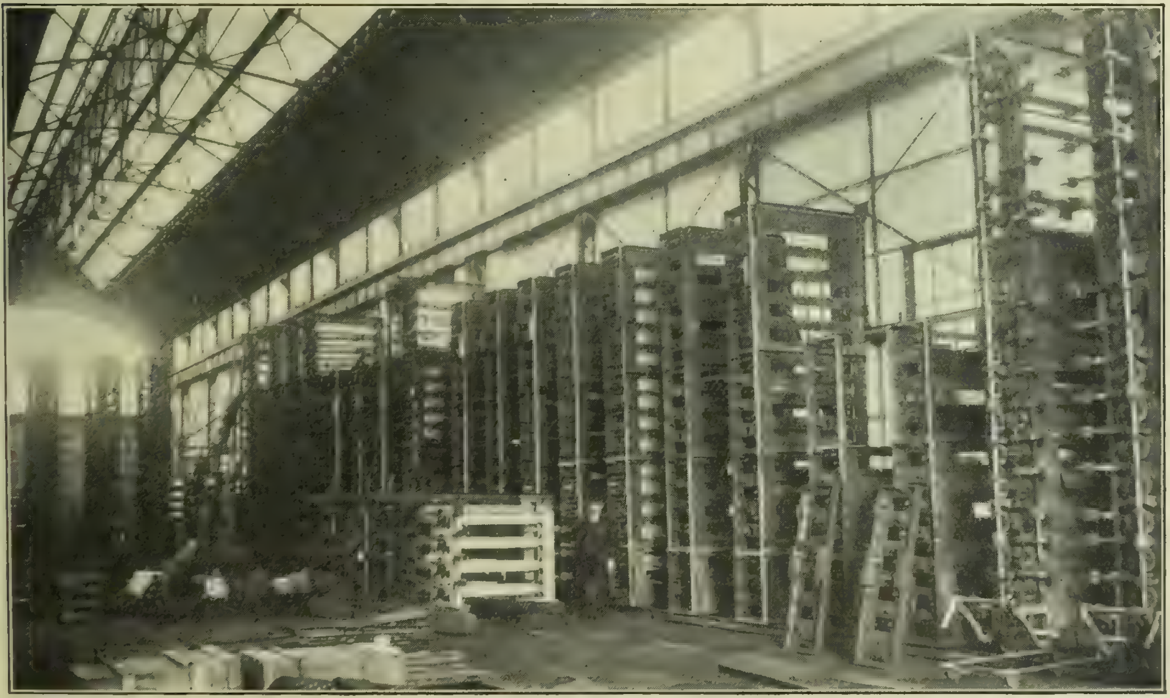
The difference between the observed conductivity and the value as calculated from the above factors is relatively small, so that the method is quite sufficiently accurate for all practical purposes.

As an example of the method, the conductivity of Jena resistant glass (approximate composition) is calculated below.

SiO_2	...	64.6	×	0.0000220	=	0.001421
B_2O_3	...	10.0	×	0.0000150	=	0.000150
ZnO	...	11.8	×	0.0000100	=	0.000118
Na_2O	...	7.4	×	0.0000160	=	0.000118
Al_2O_3	...	6.3	×	0.0000200	=	0.000126
		100.1				0.001933

---

* Ann. d. Phys. u. Chem., 67, 132.



" Fourcault " Sheet Glass Machines.

The above photograph shows part of one of the erection shops at the Ateliers Hanrez, Monceau sur Sambre, Belgium, and will convey some idea of the demand for this process of making sheet glass.

Coloured Glass and Glass Decoration.

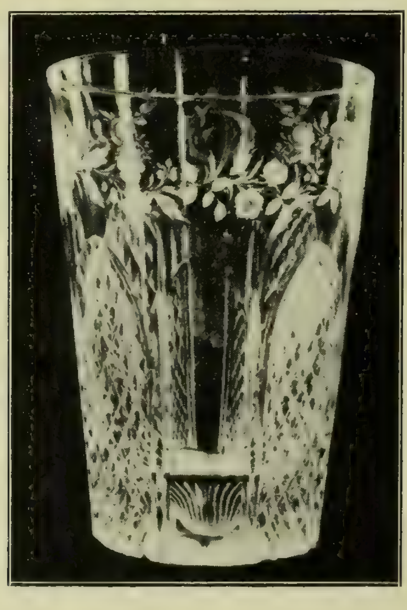
By JAMES H. GARDINER, F.Inst.P.

(*Continued*).

Leaving the subject of coloured glass which has been discussed in previous issues, we turn to that of glass decoration.

With regard to glass that is to be used for domestic purposes, particularly for table ware, one feels bound to say the less decoration the better; this, at all events, has been the writer's opinion for some years past, and there is no doubt but that the feeling is becoming general, and that it is the direct result of flooding the country with cheap decorated and pressed ware from foreign sources.

Undoubtedly the foremost place in glass decorations must be given to English cut-glass, and there is no doubt that some of the finest specimens of this craft are to be found in the English cut flint of fifty years ago, but as always happens with a first class production, it has become debased by attempts to produce it cheaply and in quantity. This result is a near parallel to the reproduction by the colour-printing process of the work of a master painter, and one can but admire the skill and ingenuity that has been expended upon the work, but there the matter ends.



The very finest English cut-glass can only be produced by skilled, and one would like to say, loving attention to every detail. Only the purest materials obtainable must be used, and the founding, working, annealing, and cutting, calls for the greatest effort in every department; when this has been faithfully done the result is a glass decoration that has a peculiar charm of its own.

The essential of such a production, in addition to purity of materials and care in each operation, is a batch composition that will give a metal of maximum refractive property and stability of surface, i.e., resistance to atmospheric influence, combined with absence of tint.

The formulæ used by the few producers of such ware is the result of years of trial and experience and is naturally kept secret.

The cutting of such glass is done with soft iron wheels fed with sand, followed by wheels of stone, very soft wood or cork, and finally polished with putty powder. This process, when properly carried out, throws up the beauty of the glass much in the same way that the cutting of an uninteresting diamond crystal brings out the flash of colour that forms the chief attraction of the gem.

One of the writer's treasures is the cut and engraved glass given in the illustration. It was produced some 40 years ago by a firm that has now ceased production.

In the attempt of late years to cheapen the production of cut-glass, the later steps of the operations just described, the use of wood and cork wheels and putty powder have been set aside, and the glass, as it leaves the stone-cutting wheel with its dull grey surface, has been "acid polished."

This operation consists in dipping the rough cut article in a bath composed of a mixture of sulphuric and hydrofluoric acids; in a few seconds this mixture removes the grey surface and gives a rather flashy gloss, which when skilfully carried out, will pass muster as wheel polish, but if two similar articles are placed side by side, there is very little doubt as to the beauty of the latter process.

This acid finish is in the writer's opinion the first step in the debasement of genuine English cut-glass. The next downward step was the production of pressed ware, in which the pattern, instead of being cut into the solid metal, is formed by pressing the fluid glass into cut steel moulds and finally passing over the formed pattern with a wheel to give a superficial appearance of cut-glass and to enable it to be wrongly called such, this is the "oleograph" in glass production—it is a triumph of skill in machinery and mass production, but from the point of view of art glass-ware it has helped to bring about the ruin of the old English glass industry.

Passing from cut-glass, the next most important stage of glass decoration is "engraving." This craft gives scope for great artistic treatment, and articles of great beauty have been and still are being produced, although the best work was done some forty or fifty years ago. The process calls for great skill and patience by the craftsman, qualities, alas, that are becoming more and more scarce in the present age; the old men are dying out, and it is next to impossible to replace them. These regrettable facts, together with the introduction of cheap methods of engraving by etching, sand-blasting, etc., are rapidly placing this beautiful craft among the things that used to be.

Embossing.

Very beautiful effects can be produced for special purposes by forming glass vessels etc., and "flashing" upon the surface thin coats of glass of different colours and then by etching or grinding the glass to different depths expose the various colours. This is usually done by the hydrofluoric acid process, protecting the glass from the acid altogether or at various stages by a resist of Brunswick black or similar substance. A process much used for mural decoration in cathedral work, is to prepare slabs of glass upon which a layer of gold-leaf has been placed, and this again flashed with ruby, blue, or green glass—this coloured coating can be wholly or partly removed with acid, exposing the gold layer; in this way some very beautiful effects can be produced.

The Deposition of Metals Upon Glass.

Although this has now practically ceased to be used for purposes of decoration on domestic ware, at one time it was quite popular. The process is not difficult now that it is possible to procure colloidal preparations of most of the noble metals; these only need to be painted on the article, which is afterwards fired so as to leave the metal firmly attached to the surface. It is, however, necessary that the composition of the glass should be suitable, soda-glass or soda-lead is the easiest to work upon; lead-glass is very difficult to deal with.

The production of metallic surfaces on glass is of great importance, particularly the formation of mirrors for optical and other scientific purposes.

For the formation of small mirrors for galvanometers, or for depositing metals upon small objects, the "cathode sputtering" process is extremely convenient and easy. This method formed the subject of a research by the late Sir William Crookes, who gives the order of electrical evaporation or sputtering for different metals under unit conditions as follows, the first being the most volatile, and the volatity falling off until aluminium and magnesium were reached, these two were practically non-volatile. The order is: palladium, gold, silver, lead, tin, iridium, iron, aluminium, magnesium.

It is only necessary to place the object in an exhausted chamber under a cathode of the metal, and pass a high-tension current for a few minutes. The coating is adherent and has a very high polish.

The production of mirrors of platinum on worked glass surfaces was very thoroughly investigated by Julius Rheinberg* a few years ago, and as the account of this work may not be generally available, the following extracts may be of interest. For obtaining an adherent film of platinum on glass suitable for optical mirrors, the glass was first very thoroughly cleaned, and was then evenly coated with an emulsion made as follows:

6 per cent. collodion dissolved in pure methyl alcohol	3 parts.
6 per cent. chloroplatinic acid dissolved in industrial spirits	3 ,,
Industrial spirits	3 ,,
1 per cent. Bismuth chloride solution	1 part.

After drying, the temperature is slowly raised so as to first char and then volatalise the collodion, which leaves the platinum in an even and brilliant film, which adheres more or less firmly to the glass according to the temperature to which it is raised.

The action of the fluorides of ammonia or soda upon glass finds application in glass decoration under the name of satin finish. The fluid used for this purpose can be purchased under the name of white fluoric acid; it can be made by cautiously adding carbonate of soda to hydrofluoric acid until all action ceases. The result is a milky-white liquid which produces the desired frosted appearance on the glass. Great care needs to be taken in working with fluoric acid preparations; it not only gives off highly dangerous fumes, but if it is allowed to get under the finger nails a most painful inflammation is set up that may take months to remove.

By employing the two fluids, hydrofluoric acid and white acid, the one for the deep sharp lines and the other for the lettering and figures, graduated and figured burettes, hydrometer jars, and similar appartus are produced. For the former, and for thermometer tubes and other small articles, the "resist" used is generally pure beeswax, which may advantageously be coloured with a little asphaltum; the article is dipped into the hot wax and kept there until it is of the same temperature, when it is slowly removed. This gives it a thin even coating, upon which the lines, figures and design can be formed with a sharp point, and it is then exposed to the acid, after which the wax is removed by warming.

A method much used for letters, figures and other designs, is to paint the glass with Brunswick black diluted with turpentine, and coat it completely with thin tin-foil. The letters or design are then cut out of the tin-foil with a sharp knife, and after cleaning with naphtha, followed by soap and water, the article is exposed to the white acid.

Another, and cheaper method, is to first coat the article with Brunswick black and then apply stencils of tin-foil; the resist can then be removed with naphtha and the acid applied.

A process largely used at the present time for lettering and printing on glass bottles, tubes, etc., is to print on the glass with rubber stamps charged with a sticky varnish, and while this is still wet to dust it with very finely powdered fusible enamel, which can be obtained in any colour. It is then only necessary to heat the articles in a gas or electric oven to the softening point of the fusible colour when it will firmly adhere to the glass.

If a soft camel-hair brush is used to apply the powdered enamel, letters of various colours can be produced at will, and the process has a wide application for

[Continued on page 200.

---

* A discussion on the Making of Reflecting Surfaces (The Physical and Optical Society of London, Nov. 26th, 1920), pp. 28-36.

American Ceramic Society.

During the week commencing February 8th the American Ceramic Society held its annual meeting and convention at Atlanta, Georgia. Five hundred and twenty-five people attended, and all were unanimous in declaring it to be the best and most successful ever held.

The papers presented to the " Glass " Division were of a very valuable nature, and a considerable amount of interesting and instructive data was made available, this being especially the case at the joint meeting of the Glass and Refractories Divisions.

We give below a brief *resumé* of some of the papers, the remainder being held over till next month.

" Glass as a Factor in Civilisation," by Alexander Silverman.

This was the opening address, and gave a rapid survey of the methods of glass manufacture from its earliest beginnings up to the present date. Mention was also made of the tremendous influence that the use of glass has had on almost every feature of human activity. The first glass factory in America was established near Jamestown, Virginia, for the production of bottles. Plate glass was first made at Creighton, Pa.

" Comparison of Glass Manufacturing Methods in Various Countries," by R. L. Frink.

Mr. Frink took the opportunity of emphasising the fact that it is necessary for the American manufacturers of machinery and equipment to keep thoroughly acquainted with the factory conditions existing in other countries to which they send their equipment, if the best results are to be obtained. What will work successfully under American factory conditions will not of necessity do so in Europe.

Speaking on the viscosity of glass, Mr. Frink said that the present viscosity measurements probably had little or no value, because they were all made on remelted cullet rather than virgin glass.

" Fundamental Requirements for Annealing Glass," by A. W. Finn.

It is essential to know the annealing temperature of the ware if the best results are to be obtained. There are several methods of determining this temperature, those depending upon the location of the region of abnormal heat absorption, and the measurement of the expansivity with temperature being recommended. Although the stresses are released very quickly at the maximum temperature of the annealing range, it does not follow that this is the best suited for expeditious work. An ordinary soda-lime glass which begins to soften at approximately 1,100° F. can be annealed in about thirty minutes at 995° F., two hours at 960° F., and ten hours at 914° F. These are approximately the most suitable temperatures to use for glass 1, 2 and 5 cms. thick respectively.

The rate of cooling depends upon the thickness of the glass and the temperature from which it is cooled. As this temperature falls the rate may be increased.

" The Application of Electric Heat to Glass Annealing," by A. N. Otis.

The author described the first electric lehrs installed in the vacuum tube and lamp departments of the General Electric Company, in 1920. The lehrs installed at the Illinois Pacific Glass Co.'s plant at San Francisco were also dealt with (see this Journal, p. 118, February, 1926).

" The History and Recent Progress in the Manufacture of Plate Glass," by J. W. Cruikshank.

Plate was first made by St. Gobain Company in 1660. The author reviewed the development in the United States, mentioning the progress in the sizes of plates made. The first were about 20 square feet, at present they are made up to 400 square feet.

The processes in use by the Ford Motor Company (this Journal, p. 493, Oct., 1924) and the Pittsburgh Plate Glass Company were described. The latter company are just doubling the output of their factory at Creighton (now nine million square feet per year), and increasing the width of the sheet from 72 to 102 inches. The opinion was expressed that Fourcault sheet glass was more absolutely flat and true than that from the Libbey-Owens machines.

" The Chemical Composition of Window Glass," by Edwin P. Arthur.

Owing to the increasing use of machines, success in the manufacture of window glass depends largely upon the proper chemical composition of the glass. A more uniform melt is required than was the case with the hand workers, as the machines cannot accommodate variations in physical characteristics.

Some of the primary requirements are : durability, stability, or resistance to weathering. From analyses of glasses produced by the different processes it is found that there is a distinct glass for each process, but that the differences between them are small, as will be seen from the following table :—

Method of Manufacture.	1. Hand	2. Lubbers	3. Slingdaff	4. Libbey	5. Fourcault
SiO_2 ...	71·9	74·3	73·1	72.8	73·8
CaO MgO ..	14.2	12.6	14.2	13.1	11.1
Na_2O ...	13·9	13·1	12.7	14·1	15·1

When operating machines, especially the Colburn and Fourcault, there is a tendency for the glass to devitrify. If it is cooled to reach a proper viscosity for working, some component of the metal may crystallize.

Recent work of Morey and Brown, in which they determined the crystallizing points of the three systems SiO_2, CaO, Na_2O, by a series of fusions and quenchings, set the temperature limits very definitely beyond which devitrification will occur. Thus, for a glass having 11 per cent. CaO it was shown that the composition for a durable glass which can be cooled to the low point without devitrification is about 15 per cent. Na_2O, and the minimum temperature about 1,000° C. These figures agree exceedingly well with practice, as a glass as mentioned will work well at 993° C., but a variation of 10° is known to cause considerable trouble.

Relative Value of Carbon Monoxide and Hydrogen as Constituents of Producer Gas*

By WILLIAM E. RICE.†

Introduction.

The ability to convert coal economically into a gaseous fuel in the gas producer is one of the factors which has made possible the comparatively large metallurgical and glass furnaces which are in use to-day, with their attendant economies in construction and operation. Two outstanding savings in favour of producer gas firing against direct coal firing are: (1) Reduction of furnace coal consumption, and (2) reduction of amount of labour required.

There are two characteristics of producer gas firing which make its application desirable in metallurgical and glass furnaces. One is the ease of temperature regulation in large units and the other is the possibility of fuel saving and ability to attain high furnace temperatures by the recovery of waste heat in regenerative furnaces. The latter is a most important factor, which has not had the study it deserves. Three methods of regeneration are possible: (1) Preheating gas and air; (2) preheating gas only; and (3) preheating air only. The last method should give high efficiency with minimum cost of initial installation and regulation, where the gas is used hot as it comes from the producer, since from five to six parts of air are used for four parts of gas by volume.

The problem of producing the best quality of gas from coal, or the quality best suited for the use to which the gas is applied, has for a long time engaged the attention of gas producer operators. This problem assumes greater importance as the cost of coal is increased by increasing labour costs and as a country's supply of natural gas diminishes.

It has been observed by furnace operators that of two gases of equal calorific value, one having a high carbon monoxide (CO) content and the other a high hydrogen (H_2) content, the gas containing a high per centage of CO is more efficient in the furnace than the gas containing a high percentage of H_2.‡

This paper presents a review of some reasons advanced by a number of investigators for the fact that gases high in CO are of greater value as heating media in furnaces than other gases of equal calorific value, but low in CO and high in H_2. The factors discussed are:—

1. Calorific values of gases.
2. Radiation from flames.
3. Flame temperature.
4. Rate of propagation of flame and limits of inflammability.
5. Dilution of water vapour.
6. Action of hydrogen flame on clay refractories.

Calorific Values of Gases.

Discussions of fuel problems involving calorific values of fuels often are not clear owing to failure to designate whether gross or net calorific values are given, or failure to distinguish clearly between these two different calorific values. Often in American technical practice only the gross calorific or total heating values of fuels are stated. The Bureau of Standards* gives the following definition of the total heating value:

> "The total heating value of a gas, expressed in the English system of units, is the number of British thermal units produced by the combustion, at constant pressure, of the amount of gas which would occupy a volume of one cubic foot at a temperature of 60° F., if saturated with water vapour, and under a pressure equivalent to that of thirty inches of mercury at 32° F., and under standard gravity, with air of the same temperature and pressure as the gas, when the products of combustion are cooled to the initial temperature of gas and air and when the water formed by combustion is condensed to the liquid state."

In operating industrial furnaces, however, the products of combustion are lost at a high temperature, and the water formed by the combustion of hydrogen leaves the furnace as vapour, carrying with it its latent heat of vaporisation. Since the gross calorific value includes an amount of heat, dependent upon the total hydrogen content of the producer gas, which is not recoverable in the furnace, the net calorific value is a truer measure of the value of a gas in metallurgical furnaces. According to the Bureau of Standards:

> "The net heating value of a gas, expressed in the English system of units, is the number of British thermal units produced by the combustion, at constant pressure, of the amount of the gas which would occupy a volume of one cubic foot at a temperature of 60° F., if saturated with water vapour and under a pressure equivalent to that of thirty inches of mercury at 32° F., and under standard gravity, with air of the same temperature and pressure as the gas, when the products of combustion are cooled to the initial temperature of gas and air and the water formed in combustion remains in the state of vapour. According to the above definitions the net heating value is less than the total heating value by an

---

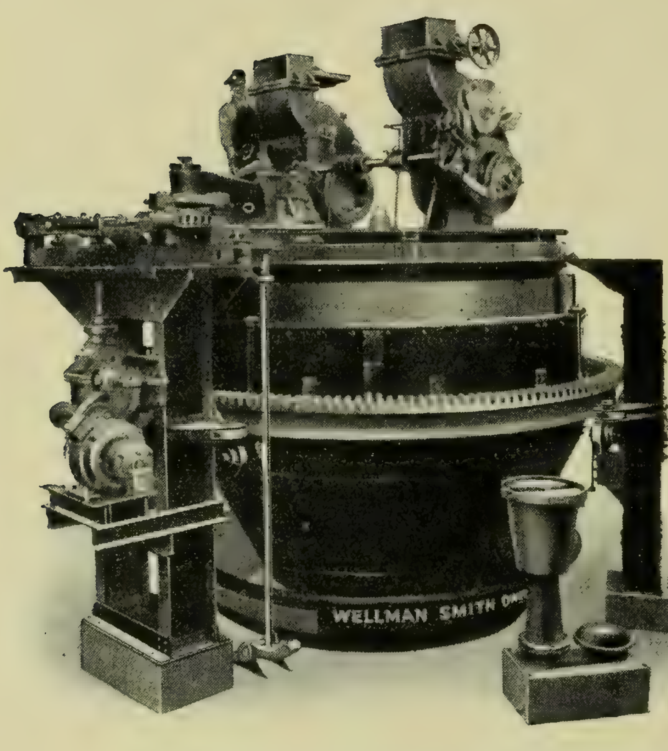
* Published by permission of the Director, U.S. Bureau of Mines.

† Assistant fuel engineer, Pittsburgh Experiment Station, U.S. Bureau of Mines.

‡ Clements, Fred, British steel works gas-producer practice. Jour. Iron & Steel Inst., Vol. CVII, No. 1, 1923, pp. 97-136. Work of the Mississippi Valley Experiment Station of the U.S. Bureau of Mines, Zn (Bull. Am. Zinc Inst.) Vol. 7, No. 6-7, pp. 1-5, June-July, 1924.

* Waidner, C. W., and Mueller, E. F., Industrial gas calorimetry Bureau of Standards Tech. Paper 36, 1914, 150 pp.

WELLMAN AUTOMATIC GAS MACHINES



These machines have proved to be of the greatest value in Glass Works.

One Glass Works after making exhaustive comparative tests has installed a total of

14 Wellman Producers.

The high efficiency and speed of working is due to the special features described in our booklet for which every Glass Works Manager and Engineer should write.

No. 10 TO GASIFY UP TO 4,000-lbs. COAL PER HOUR.
No. 8 TO GASIFY UP TO 2,600-lbs. COAL PER HOUR.

THE WELLMAN SMITH OWEN ENG. CORP., LTD.

36-38, KINGSWAY, LONDON, W.C.2.
WORKS :: :: DARLASTON, S. STAFFS.

Telephones: HOLBORN 2588/9. *Telegrams:* "PRINCIPIUM, WESTCENT, LONDON."

amount of heat equal to the latent heat of vaporization, at the initial temperature of the gas and air, of the water formed by the combustion of gas.

Table 1 gives the gross and net calorific values of the gases commonly determined in analyses of producer gas. The data given are from a table of standards compiled in the Bureau of Mines gas laboratory.

TABLE I.

Calorific values of gases in producer gas.

Gas.	Formula.	Molecular weight.	B.T.U. per cu. ft. at 60° F. and 29.92 in. mercury.	
			Gross.	Net.
Carbon monoxide	CO	28.00	323	323
Hydrogen	H_2	2.016	352	279
Methane	CH_4	16.03	1008	916
Ethylene	C_2H_4	26.03	1583	1491

The calorific value of any mixture of gases is an additive property that can be computed if the proportion and calorific value of each constituent is known.* For example: in Table 2 are computed the gross and net calorific values of a sample of gas generated from Illinois coal in a W.S.M. mechanical gas producer.†

TABLE II.

Calorific values of producer gas from Illinois coal.

Gas analysis (volumetric), per cent.		Computation of calorific value in B.T.U. per cubic feet at 60° F. and 29.92 in. mercury.	
		Gross.	Net.
CO_2	5.2	——	——
CO	24.8	0.248 × 323 = 80.1	0.248 × 323 = 80.1
H_2	12.2	0.122 × 325 = 39.7	0.122 × 279 = 34.0
CH_4	2.8	0.028 × 1008 = 28.2	0.026 × 916 = 25.6
C_2H_4	0.5	0.005 × 1583 = 7.9	0.005 × 1491 = 7.5
O_2	0.0	——	——
N_2	54.5	——	——
Total combustible	40.3	—— ——	—— ——
Calorific value	... ...	155.9	147.2

While the calorific values thus calculated provide a satisfactory means of comparison for gas-producer operation, they do not represent the exact calorific value of the raw producer gas as it enters the furnace from the producer, because they do not include the calorific value of the tar and soot which are carried into the furnace with the gas and there burned. This tar and soot not only have high calorific value, but they burn with a luminous flame, thereby adding materially to the heat radiating value of producer gas in this type of furnace.* The theory has been advanced that slow combustion of such heavy hydrocarbons as the tarry vapours enable heat to be developed throughout the course of a furnace chamber instead of intense local heat near the ports of the combustion chamber.†

In Table 1 it is seen that the gross calorific values of equal volumes of CO and H_2 are practically the same, while the net calorific value of CO is higher than that of H_2, therefore, since these are the principal constituents of the combustible in producer gas, a change in the proportion of CO to H_2 cannot result in a change of more than 1 B.t.u. in the gross calorific value of the gas, while an increase in the proportion of H_2 in the combustible will result in a decrease in the net calorific value of the gas. This is one reason why two gases of the same gross calorific value may not have the same heating value when burned in a furnace.

But the reduction in net calorific value due to an increase in the ratio of H_2 to CO is not sufficient to account for the differences apparent in furnace opera-

---

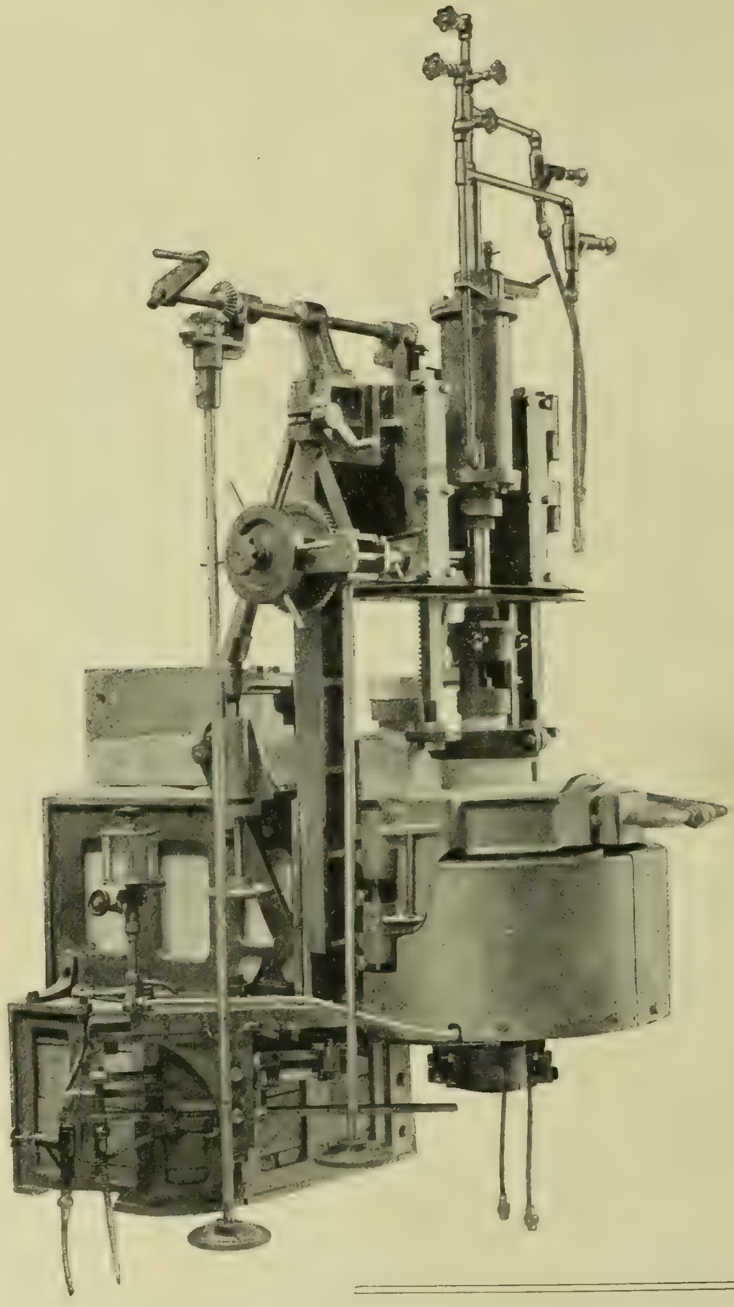
* Kent's Mechanical Engineers' Handbook, 10th Edition, John Wiley & Sons, New York, 1923. Gas producers, by John Blizard, pp. 1203-1228, contains tables for rapid calculation of calorific value of producer gas.

† Test results from operating producer. Personal communication, Wellman-Seaver-Morgan Co., Dec., 1924.

* Clements, Fred., British steel works gas-producer practice, work cited.

† Stobie, Victor, Jour. Iron and Steel Inst., Vol. LXXIII, No. 1, 1908, p. 169.

The "RANKIN" Automatic Glass Feeder.



RESULTS JUSTIFY CLAIMS.

Claims without justification are futile.

The need for automatic production is admitted by every glass manufacturer. The question is—what mechanism can be installed with the assurance of the best results?

The "RANKIN" record is unrivalled in the Glass Feeder world. Its history is unique. In no instance has a "RANKIN" installation once installed been superseded. On the contrary, wherever it has been adopted further installations have followed.

The latest proof of this claim is a repeat order for **TWELVE FEEDERS** from a Glass Manufacturing Company, who originally put in one Feeder for comparison with other similar devices. This we believe to be

THE LARGEST INDIVIDUAL ORDER EVER PLACED FOR AUTOMATIC FEEDERS

and represents a great triumph for an All-British Built Feeder.

The mechanism, material and finish are of the highest possible quality. The "RANKIN" Feeder is built for service and will outlast all others.

Demonstrations of the RANKIN AUTOMATIC GLASS FEEDER will be arranged by appointment.

For Illustrations, Descriptive details and terms apply to :

THE RANKIN AUTOMATIC GLASS FEEDER CO.,
1, CHARTERHOUSE STREET, LONDON, E.C.1.
Telegrams : Natiglaso, London. *Telephone Nos. :* Holborn, 140 and 141.

tion, so it is necessary to turn to some other properties of the gases to account for the higher furnace efficiencies given by CO.

Radiation from Flames.

Heat is imparted to the furnace charge from the flame by convection and radiation. The amount of heat the charge receives by convection is a function of a flame temperature, and will be mentioned later under that subject. The heat radiated to the charge is in part a function of the flame temperature and a function of the luminosity of the flame, but is also a function of the composition of the fuel gas.

Radiation of heat from flames has been the subject of a great deal of experimental investigation, the results of which demonstrate in theory what has long been known empirically—that is, that CO has greater heating value than H_2 in most heating furnace operations. Helmholtz (Die Licht und Warmestrahlung verbrennender Gase, Berlin, 1890)* found that in non-luminous flames H_2 radiated 3.61 per cent. and CO 8.74 per cent. of the total heat of combustion. About the same time (1890) W. H. Julius proved by spectroscopic analysis that the radiation from different flames is due to the process of formation of CO_2 and H_2O molecules. Helmholtz' experiments confirm Julius' work by showing that the radiation from flames of complex hydrocarbon is dependent on the number of molecules of CO_2 and H_2O formed.†

Helmholtz' experiments were made with small flames, approximately ¼ inch in diameter. Callender‡ repeated the experiments using larger flames, and found that radiation increases with the size of the flame. The report states that there are two reasons for this: first that since flame is transparent to radiation more radiation is received from the inside of the larger flame, and second that the larger flame cools less rapidly, hence the newly-formed CO_2 and H_2O molecules are in a condition to radiate heat for a longer time. Callender also found that when the air supply is reduced below the amount necessary for complete combustion the size of the flame and the heat radiated increase.

The results of these experiments are directly applicable to furnaces in which the furnace chamber is wholly filled with flame and the gas is burned with a deficiency of air. Both of these conditions increase radiation from the flame. Under such conditions the advantage of CO over H_2 as a fuel for the furnace is at once apparent, since it has been shown that when burned under the same conditions, radiation from the CO flame is nearly 2½ times as great as from the H_2 flame.§

Radiation from the flame is further increased when the flame is made luminous, which occurs when particles of carbon—either soot from the producer or from partial combustion of gases containing carbon— are present in the flame.

Flame Temperature.

As previously stated, the charge receives its heat from the flame by convection and radiation. The amount of heat which is made available to the charge depends upon the difference between the temperature of the charge and the temperature of the flame which imparts heat to it—that is, only the thermal head above the temperature of the charge is available to impart heat to the charge and carry on thermal processes.

It then becomes evident that it is generally desirable to operate the furnace with as high flame temperature as possible, limited, of course, by the possibility of injuring the charge and by the refractoriness of the furnace lining, because with a high flame temperature a large proportion of the total heat of combustion can be imparted to the charge and less fuel will be required. Also, with a higher flame temperature and the accompanying more rapid heat transference, the time of heating will be shortened, or, in a given time, the output of the furnace will be greater.

In Table 3 the calculated theoretical flame temperature of four samples of producer gas are given to show that with producer gases of approximately the same calorific value higher flame temperatures are obtained from gases high in CO than from gases high in H_2. The gas samples are selected from Bone and Wheeler's tests.*

Heat transference from hot gases by convection is expressed mathematically by the formula:†

$$H_c = (A + B \rho V)\,(t_2 - t_1)$$

in which H_c is the amount of heat transferred by convection from a hot body at temperature t_2 to a cooler body at temperature t_1, A and B being constants and V and ρ the velocity and density of the fluid. A is small, so that H_c is approximately proportional to V.

Heat transference by radiation is expressed by the Stefan-Boltzmann formula‡ :—

$$H_r = E\alpha(t_2^4 - t_1^4)$$

where H_r is the amount of heat transferred by radiation from a hot body at absolute temperature t_2 to another body at a lower absolute temperature t_1: E is a factor dependent upon the emissivities of the two bodies and α is a constant. From these formulae it is apparent that convection will be increased somewhat by a small increase in flame temperature, and that radiation will be greatly increased by the same small increase in flame temperature, since the radiation of heat increases with the difference between the fourth powers of the temperature of the hot gases and the charge temperature.

For illustration: from Table 3 take sample No. 2 and 4 of producer gas, which, though having but 1 B.t.u. difference in gross calorific value, show a difference of 60° F. in calculated flame temperatures corrected for radiation (b), due to a higher percentage of CO in sample No. 2. If the temperature of the charge is

---

* Kent's Mechanical Engineers' Handbook, p. 1226, work cited.

† Bone, W. A., Coal and its scientific uses. Longman's Green and Co., New York, 1919.

‡ British Association Reports, Sheffield, 1910.

§ Some of the latest research on this subject is ably discussed by Haslam, R. T., Lovell, W. G., and Hunneman, R. D., Radiation from non-luminous flames, Ind. and Eng. Chem., Vol. 17, No. 3, March, 1925 pp. 272-7.

* Bone, W. A., and Wheeler, R. V., An investigation on the use of steam in gas-producer practice. Jour. Iron and Steel Inst., Vol. 73, No. 1, 1907, p. 126.

† Glazebrook, Richard, and 30 others, A dictionary of applied physics, Vol. 1, 1922, pp. 470-7. MacMillan & Co., London

‡ Langmuir, Irving, Convection and radiation of heat, Trans. Amer. Electrochem. Soc., Vol. 23, 1913, p. 299.

PARKINSON & SPENCER, Ltd.

Ambler Thorn Fireclay Works,
HALIFAX, YORKSHIRE.

ESTABLISHED 1800.

Telephone : No. 1207.
Telegrams : Parkinson & Spencer, 1207 Halifax

Manufacturers of Refractory Goods of every description for the Glass industry, viz :

GLASS-HOUSE POT CLAY, FIRE CLAY, FIREBRICKS, TANK BLOCKS, BINDERS, etc.

Our Tank Blocks are unsurpassed for quality and durability.

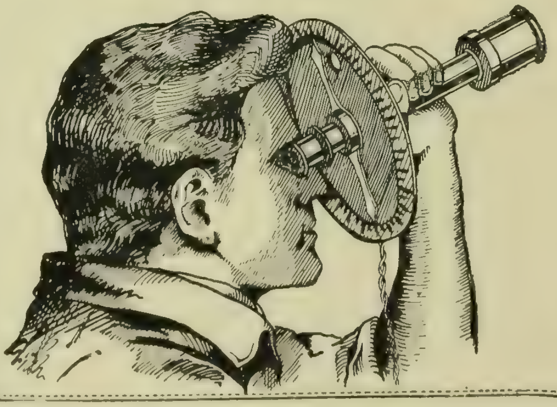
WE SPECIALIZE IN BEST POT CLAY MATERIAL.

New Plant recently erected for the cutting and dressing of Tank Blocks to any dimensions.

FAVOUR US WITH YOUR ORDERS AND YOU WILL BE SATISFIED WITH RESULTS.

Cambridge
OPTICAL PYROMETER
FOR TEMPERATURES UP TO 4,000° C.

List No. 190-V.
sent on request.



Can be sighted on small objects.

Will read any temperatures giving visible radiations.

Operated by unskilled workmen.

Practically indestructible.

Portable. Accurate. Self-Checking.

Each instrument carries a National Physical Laboratory Certificate.

CAMBRIDGE
INSTRUMENT Co LTD

WORKS - LONDON. & CAMBRIDGE
Head Office & Showrooms - 45.GROSVENOR PLACE, LONDON . S.W

2581

assumed to be 2660° absolute (2200° F.), then for sample No. 4 the factor

$$(t_2^4 - t_1^4) = 111 \times 10^{12},$$

and for sample No. 2,

$$(t_2^4 - t_1^4) = 122 \times 10^{12},$$

or an increase of 10 per cent. in the amount of heat radiated. However, because of the fact that combustion in the furnace is not instantaneous and for other reasons, the true flame temperature is always several hundred degrees lower than the theoretical flame temperature. If the same calculations be repeated with flame temperatures of 2500° F. and 2560° F. for samples No. 4 and 2 respectively, it will be seen that at actual furnace temperatures an increase of 60° F. in flame temperature gives an even greater increase in the rate of heat transference by radiation, for then for sample No. 4,

$$(t_2^4 - t_1^4) = 27 \times 10^{12},$$

and for sample No. 2,

$$(t_2^4 - t_1^4) = 33 \times 10^{12},$$

or an increase of 16.5 per cent. in the amount of heat radiated.

TABLE III.
Theoretical flame temperatures of producer gas.

Producer Gas.		Sample No. 1.	Sample No. 2.	Sample No. 3.	Sample No. 4.
CO_2	per cent.	2.35	5.10	6.95	9.15
CO	,,	31.60	27.30	25.40	21.70
H_2	,,	11.60	15.50	18.30	19.65
CH_4	,,	3.05	3.05	3.40	3.40
N_2	,,	51.40	49.05	45.95	46.10
Gross calorific value	B.t.u.	170.5	169.4	175.8	168.3
Net calorific value	,,	162.4	159.4	164.2	156.1
(*a*) Theoretical flame temperature	°F.	3375	3320	3330	3240
(*b*) Theoretical flame termperature less calculated radiation from non-luminous flame	°F.	3195	3160	3175	3100
Products of combustion :					
CO_2	per cent.	17.5	16.9	16.6	16.3
H_2O	,,	8.4	10.3	11.7	12.5
N_2	,,	74.1	72.8	71.7	71.2
At flue-gas temp. of 2200° F. :					
Heat utilised in furnace	,,	38.7	37.7	38.0	36.0
Heat lost in stack gases	,,	61.3	62.3	62.0	64.0

It should be remembered that calculated flame temperatures or calorific intensities are not attainable in practice. The nearness to which actual flame temperatures may approach theoretical flame temperatures is governed by the composition of the gas and the conditions of furnace operation[*]

Flames are complicated phenomena and the equations given above have been applied with only tolerable success in actual operations. However, the factor $(t_2 - t_1)$ for convection and $(t_2^4 - t_1^4)$ for radiation, seem to provide a satisfactory means for comparing rates of heat transference from hot gases, and, if used with suitable constants, may express actual rates of heat transference.[*]

The last two items in Table 3 show gross furnace efficiences and stack losses for the four gas samples. The calculated furnace efficiency includes all of the heat that would be given up by the gases in the furnace if combustion were complete, with no excess air, and if the gases left the furnace at 2200° F.; it includes a large amount of heat which is not utilized in performing useful work, part of which is used to heat the masonry of the furnace and part is lost from the furnace by conduction, radiation, and convection.

Furnace efficiencies are lower when the gas has a high hydrogen content. This is because of the heat carried away in the water vapour which is formed by the combustion of hydrogen. Of course, these efficiencies obtained from calculations based on the purely arbitrary assumption that the products of combustion leave the furnace at 2200° F. can not be taken as representative of the true efficiencies given by the different gases in furnace operation, because the flue-gas temperature will be governed by the nature of the thermal process and by the efficiency of heat transfer in the furnace, which is in part a function of the composition of the gases, as pointed out in the discussion of radiation from flames. The calculations do show, however, a slight advantage in favour of carbon monoxide.

(To be continued.)

---

[*] Bone, W. A., "Coal and its Scientific Uses." Work cited.

[*] The following references contain data on heat transference from flames: Wood, R. W., Physical Optics, The MacMillan Co., New York, 1911, pp. 591-623.

Kreisinger, H., and Ray, W. T., The transmission of heat into steam boilers, Bulletin 18, Bureau of Mines, 1912, 180 pp.

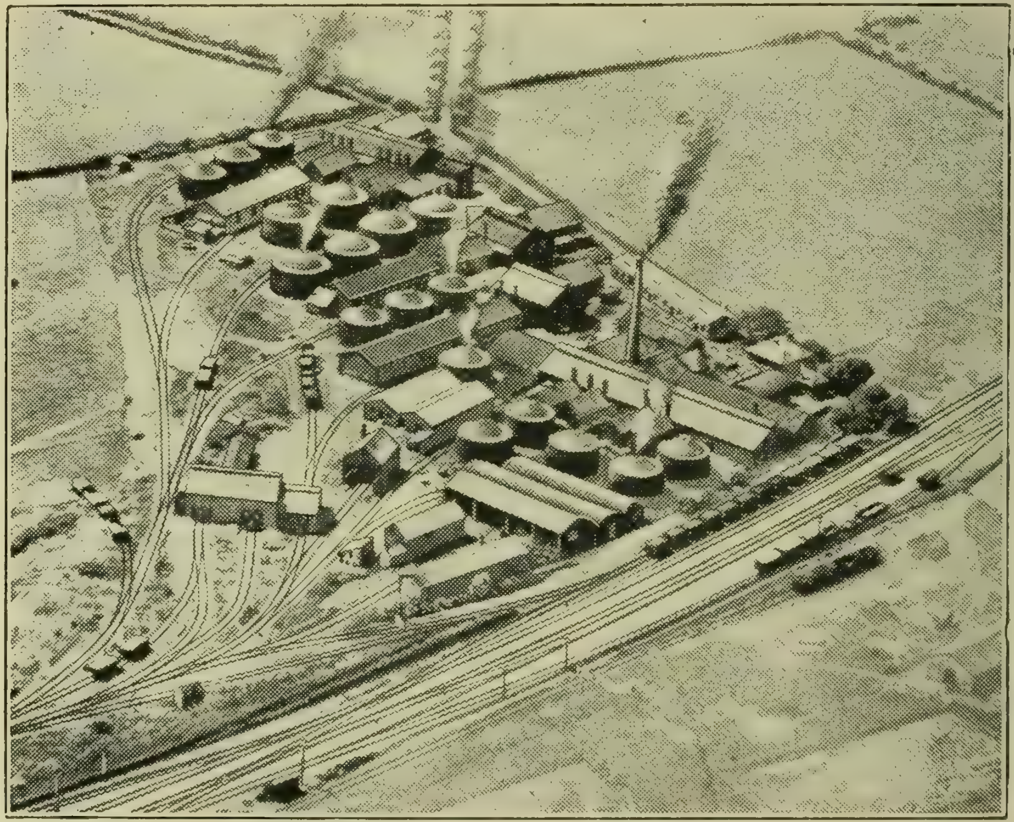
Bell, J. H., An outline of the theory of heat transmission and absorption in application to ordinary engineering problems. Proc. Eng. Soc. West. Pa., Vol. 32, 1916-17, pp. 797-845.

Kreisinger, H., Blizard, John, Augustine, S. E., and Cross, B. J., An investigation of powdered coal as fuel for power-plant boilers. Bull, 223, Bureau of Mines, 1916, 92 pp.

THE MOST DURABLE **BRICK** *MADE FOR* **GLASS FURNACES.**

STEPHENS SILICA "C"

EXTREMELY REFRACTORY, TOUGH AND DURABLE.



VIEW TAKEN FROM AN AEROPLANE.

Kiln Capacity 1½ Million Bricks. Works Cover over 9 Acres.

SUPER SILICA CEMENT for setting SILICA BRICK.

Used by most of the principal GLASS WORKS.

STEPHENS & CO., KIDWELLY.

The Society of Glass Technology.

The eighty-eighth meeting of the Society, held in Stourbridge on March 17th, 1926, was undoubtedly a great success. The friendly spirit which is becoming quite a feature of these gatherings was very evident and members had ample opportunity for indulging the desire for discussion of points of interest not on the official programme.

A number of members stayed in Birmingham on the night of the 16th, and arrived in Stourbridge full of the "joie de vivre," if appearances were to be judged.

Interesting Visits.

(1). The party, numbering about thirty, assembled at the Coalbournhill Glassworks, where, by the courtesy of Messrs. Thomas Webb, Corbett and Co., Ltd., the methods of production of jugs, wine glasses and table ware in general were inspected. The various methods employed for the decoration of the glassware, including cutting, intaglio, engraving and etching, were also shown, and the visitors expressed their sincere appreciation.

(2.) Leaving the Glassworks, a visit was then paid to the home of Mr. Philip Pargeter in Stourbridge. Mr. Pargeter kindly showed his fine specimens of cameo work, including the famous reproduction of the Portland Vase, and the original Milton Vase, designed and executed by the late Mr. John Northwood, senior. The blanks for these pieces were made at the Red House Glass Works, Wordsley, belonging to Mr. Pargeter's uncle, who purchased the cameo pieces for a sum running into four figures. Rare specimens of Old English, Venetian, and Bohemian glass work were also on view, and a hearty vote of thanks was accorded to Mr. Pargeter for his hospitality and courtesy.

The Luncheon.

Some forty members assembled for luncheon at the Talbot Hotel, the President of the Society, Mr. T. C. Moorshead, presiding. The Mayor of Stourbridge, (Mr. R. L. Mathews), Mr. J. S. Williams-Thomas, O.B.E., and Mr. W. H. Stuart were the guests of the Society.

The President proposed the toast, "The Glass Industry of Stourbridge," coupled with the names of the two distinguished guests, Mr. J. S. Williams-Thomas and Mr. W. H. Stuart. This was the President's first visit to Stourbridge, and he had never had a previous opportunity of visiting one of the works which had made the district so famous. He had, however, heard from the late Mr. Libbey, in the United States, much about the famous glasshouses, where much of Mr. Libbey's early knowledge was gained.

In the course of his reply Mr. Williams-Thomas expressed his thanks for the good wishes extended to the Stourbridge glass trade, and outlined some of the grave disadvantages under which it was labouring. He and Mr. Stuart had been connected with it for over sixty years; they were proud of it, and appreciated all that was done for it by the Society of Glass Technology. Much help had already been given by the Department at Sheffiield University, and he hoped that greater discoveries still lay in store for them, in order to keep up with the times and maintain the great name attached to the glassware of the district. With Professor Turner and his colleagues as advisers and helpers, the future could be faced with confidence.

Mr. Stuart supported what Mr. Williams-Thomas had said, and spoke of the copying of patterns practised by the foreigner. He maintained that in the production of the best goods, and in the backing of British goods by the British public, lay the hope for the future existence and prosperity of the glass trade.

The Mayor of Stourbridge submitted the toast, "The Continued Success of the Society of Glass Technology" coupled with the name of Professor Turner. He testified to the reputation held in New York by Stourbridge 35 years ago, for the production of the finest glass in the world. This reputation was still upheld. Considerable benefit must accrue, he said, from the study of the science of the industry, and he wished the greatest success to the Society which aimed at helping all interested in the glass trade throughout the world.

Professor Turner, being, as he said, "an infant in arms," called upon Mr. W. Butterworth (Senior) President-designate, to reply to the toast. Mr Butterworth spoke of the diversity of uses of glass, combined with its wonderful beauty, and said he was proud of the glass trade. The trade should, he said, be proud of itself, not only for its glass, but also for its glassmakers, no finer examples of whom could be found, than the two guests present.

The Eighty-eighth Ordinary Meeting.

Mr. T. C. Moorshead presided at the meeting which followed the luncheon. One application for collective, and three for ordinary membership were accepted, the applications being received from Norway, Canada and Russia.

Three papers were read and discussed, the first of these, presented by Professor Turner, being, "**The Flashing of English Crystal by Cobalt Blue Glass,**" by Professor W. E. S. Turner, and Mr. F. Winks, M.Sc.Tech.

The authors had determined the coefficients of expansion of two series of glasses from the ordinary room temperatures, up to the softening range, with a view to investigating whether the failures in flashing cobalt blue glass on to clear crystal were due to a difference in the expansion co-efficients. The two series of glasses studied were a lime-soda-silica, and a lead crystal series and to the parent member, definite increments of cobalt were introduced, until a maximum CoO content of 0.5 per cent. was reached.

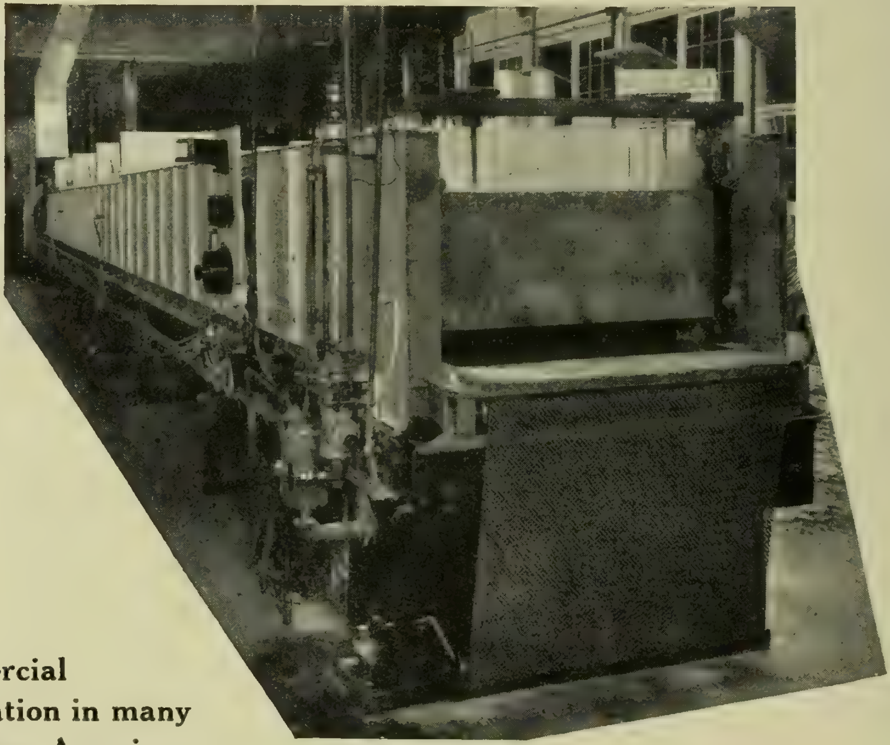
The results obtained showed that the introduction

Another Scientific Development

THE HARTFORD LEHR

IS CREATING

A NEW STANDARD OF ANNEALING



Commercial operation in many leading American factories has proved that

THE HARTFORD LEHR

1. Gives " GRADE A " ANNEALING at all times.
2. Saves FUEL (as high as 85% saving has been shown).
3. ,, WARE (No " Lehr Loss ").
4. ,, LABOUR.
5. ,, SPACE.
6. ,, UPKEEP EXPENSE.

The British Hartford-Fairmont Syndicate Ltd.

142 - 143 Audrey House, Ely Place, London, E.C.1

"HARTFORD" AUTOMATIC FEEDERS - FORMING MACHINES - LEHRS

of CoO into the glasses modified the expansion to a very slight extent. The failures experienced in attempting to weld a blue glass on to a clear one, were not due to appreciable differences in the expansion coefficients, but rather to the differences in the rates at which the two glasses cool and set. The addition of the colouring oxide in both types of glasses studied, tended to shorten the working range, hence, the practice of softening the blue glass somewhat, was beneficial.

An interesting discussion followed, in which several members took part, and Professor Turner replied.

The second paper, presented by Professor Turner, was entitled " **Some Notes on the Use of Sillimanite in Glass Works Practice,**" by Mr. A. Cousen, M.Sc., and Professor W. E. S. Turner.

Professor Turner stated that the main object of giving this paper was to promote discussion, and to induce manufacturers to give their observations on the behaviour of sillimanite in works practice. Results of laboratory tests had previously been given, and it was hoped that results of tests on a commercial scale could now be discussed.

The Professor stated that sillimanite had, to his knowledge, been employed in works practice for the following purposes :—

(1) for pots or potettes,
(2) for the hearths of gas ports,
(3) for covering sieges of pot furnaces,
(4) for the construction of gates or dams in flow feeders, and the Danner tube-drawing machine,
(5) for pot rings,
(6) in the form of slip or paste in regenerator stacks.

Sillimanite showed at its best under high temperature firing. Pots and potettes had been found to resist corrosion by glass better than those made of clay. The gaps produced between the blocks in the gas ports examined, emphasized the need for initial firing to a high temperature. All reports of sillimanite in siege linings appeared to be satisfactory when sufficient bonding ball-clay was used in the mixture, and a sufficiently thick layer was applied. When fired to high temperatures beforehand, gates, and pot rings gave satisfactory service, while regenerator blocks were well preserved by a slip or paste of seven parts of sillimanite to three parts of ball-clay.

The President thanked Professor Turner for this interesting contribution, and said that he was particularly interested in the lining of regenerator stacks.

Mr. H. Webb asked what was the lowest temperature at which sillimanite gave good service.

Mr. J. Northwood asked in what type of furnace the sillimanite sieges had been tried, as the mechanical action necessary in removing the rubbish from an old type direct-fired furnace, might seriously affect the life of the sillimanite. He advised getting up a ring and a pot together.

Mr. W. F. Pearson enquired as to the composition of the glass, the temperature of the furnace, and the composition of the sillimanite mixture used in the case of the remarkably good potette cited by the authors of the paper.

Mr. E. A. Coad-Pryor asked in what types of glass the sillimanite rings would float.

Mr. E. Threlfall raised the question of uniformity of composition of sillimanite on the market.

Mr. F. G. Clark stated that sillimanite gave very good results in resisting corrosion by glass except when salt cake was used in the batch.

In the course of his reply, Professor Turner said that he was inclined to say that sillimanite was effective at temperatures above 1100° C. He might add to the information he had previously given, a statement that sillimanite bricks or blocks were quite useless when placed in a stream of dust carrying highly ferruginous ash.

The third paper, by Mr. P. Marson, entitled, " **Some Remarks upon Recuperative Gas-fired Furnace Practice,**" was read for the author by Mr. F. G. Clark.

The author preferred the type of recuperative furnace with vertical air channels, originally designed by Gaillard and Hallot, because the tendency to short circuit was less in this type than any other. The need for experienced control was emphasised, as under inefficient handling, a whole furnace full of pots could be ruined in a night.

Attention was directed to the choice of suitable, hard-burnt, and well shrunk refractories for the construction of the furnace chamber and its siege. From his own experience, the author found that the best and cheapest form of siege was one made up with ground potsherds

[*Continued on page* 197.

FURTHER DEVELOPMENTS
IN
FOSTER PYROMETERS

Several new forms of Pyrometers, which will be of interest to Glassworks engineers, are described in a new catalogue, just ready.

Ask for Book No. 42S.

FOSTER INSTRUMENT CO.,
LETCHWORTH, HERTS.
" The Pyrometer People."

Telephone: Letchworth 26.
Telegrams: "Resilia, Letchworth."

TELEGRAMS:
"GLASMACHIN, ESTRAND, LONDON.
CABLES:
"GLASMACHIN, LONDON"
CODE:
BENTLEY'S.
TELEPHONE:
CENTRAL 5985.

C. SAXTON, A.M.I.E.E., M. IRON AND STEEL INST., Etc.

CONSULTING ENGINEER

Talbot House,
Arundel Street,
Strand, London, W.C.2.

BOTTLE MOULDS

ORDER YOUR MOULDS FROM

E. LUNN & Co., MOUNT STREET, GLASGOW.

Largest MAKERS of MOULDS in the UNITED KINGDOM

Quick Deliveries and Complete Satisfaction Guaranteed.

MOULDS FOR ALL TYPES OF MACHINES SUPPLIED

ALL MOULDS MADE OF CHILLED CASTINGS ONLY.

Telephone— WESTERN 2792.
Telegrams— GLASMOLD, GLASGOW.

ONE OF OUR RECENT TESTIMONIALS—

"We have one set of Ordinary Round Quart Moulds which you supplied to us which have been working for 2½ years. These are still in perfect condition, showing no cracks or any other flaw in the metal. They have been working almost continuously for the above period, only being off the machines for a week or two at a time. We have also other moulds in Square, Oval and special shapes which have been working quite as long as the Ordinary Round Quarts, although not so continuously, and these also are in perfect condition. We have always found your moulds more satisfactory than any others, and the metal you use is much more durable than any supplied by other firms."

Reference on our Testimonial File : A.B. 91.

Trade "TWENTY MULE TEAM" Mark

Granulated

BORAX

Specially refined for

ENAMELLERS AND POTTERS

BRITISH MANUFACTURE.
Guaranteed 99·50% pure.
Uniform colour and texture.
Free running granules.
No colorific impurities.

BORAX CONSOLIDATED LTD,
16, Eastcheap, LONDON, E.C.3.

TRADE NOTES.

Mr. R. L. Frink is once more in England and is looking up his old friends and acquaintances.

◆ ◆ ◆

Mr. V. Mulholland, of the Hartford Empire Company, who was chiefly responsible for the development of the new " Hartford Lehr " (see our February issue) is now in England and numerous manufacturers have had the opportunity of discussing this extremely interesting equipment with him.

◆ ◆ ◆

According to information just received from Wm. J. Miller, Inc., several new features have been introduced in connection with the automatic feeders made by the company.

By the use of a special aluminium alloy the weight of the shear mechanism has been reduced about ninety pounds, whilst an additional adjustment has been incorporated, whereby the blades can be adjusted vertically whilst in operation, thus obviating the use of shims and liners.

All feeders now being shipped will be provided with these improvements which have been thoroughly tried out.

◆ ◆ ◆

Upon the invitation of the Directors, the Mayor and Mayoress of Salford and a number of other ladies and gentlemen recently visited the glassworks of Butterworth Bros., Ltd., Manchester, which have just been largely extended. After proceeding through the glasshouses, and watching the actual manipulation of the glass at the furnaces, the visitors were shown the various finishing processes. In the glass-cutting department each member of the party was presented with cut-glass napkin rings as souvenirs of the occasion.

At the close of the visit the party was entertained to lunch by the managing director of the company, Mr. Walter Butterworth, M.A., J.P. In proposing a vote of thanks the Mayor of Salford (Alderman Delves, J.P.) spoke of the happy relationship existing between Mr. Butterworth and his employees.

◆ ◆ ◆

Owing to the conspicuous success of the British Industries Fair in February, it has been definitely decided to hold the Fair again next year at approximately the same time. Many exhibitors this year have already reserved space for next year.

◆ ◆ ◆

We understand that considerable success has been obtained on the Continent in the use of a special form of powdered pumice for the manufacture of insulating bricks and powders

◆ ◆ ◆

The Federation of British Industries has set up a Committee to consider in detail the reactions upon industry of the recommendations embodied in the report of the Coal Commission.

According to a notice issued by the D.O.T., reports from Prague indicate that the local glass industry has of late suffered from a general decline of employment. Export especially shows a marked decrease, mainly owing to the new increased customs duties in Germany. Even in January when all these new increases had not entered into force exports to Germany showed a decrease of 200 wagons. Since then the situation has got worse especially as regards the hollow glass industry. It has been generally remarked that this branch of industry, even in its cheaper products, is being ousted from foreign markets owing to the revival of competing industries. The decrease in orders has caused a restriction of output. Many firms have, it is stated, reduced their production, and in some cases workers have been dismissed.

◆ ◆ ◆

In connection with the Competition of Industrial Designs, organised by the Royal Society of Arts, by kind permission of the Executive Council of the Imperial Institute, this year's Competition will be held in the Upper East Gallery of the Imperial Institute, South Kensington. Full particulars of the Scholarships and Prizes offered in connection with the Competition can be obtained from the Secretary of the Royal Society of Arts, Adelphi, London, W.C.2. Applications for forms of entry, labels, and instructions must be sent to the Secretary between the 1st and 15th of May.

◆ ◆ ◆

It is hoped that the " Stained Glass Association of America " who are meeting in England the latter end of May and early June, will attend the Annual Dinner of the Society of Glass Technology.

◆ ◆ ◆

In connection with the proposed Federation of Glass Bottle and Container Manufacturers, we understand that a meeting was held in London on March 30th, at which it was decided to proceed with the scheme. A committee was elected to discuss details and report to a meeting to be called later.

◆ ◆ ◆

According to a statement in the House of Commons by Mr. J. P. Hannon, the percentage of unemployed in the glass bottle making industry was 20.1 per cent. on January 25th this year.

◆ ◆ ◆

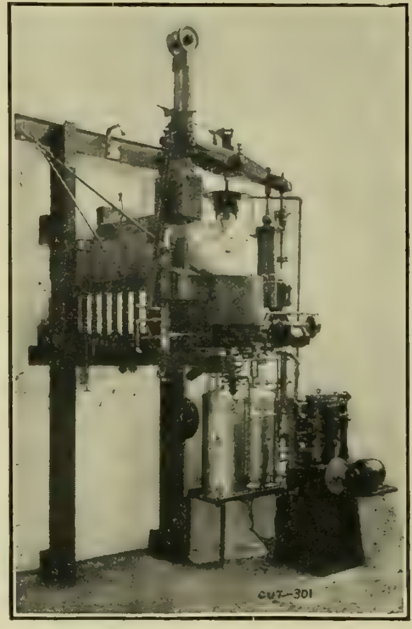
Sir W. Peat has been appointed receiver for the Rylands Glass and Engineering Co., Ltd., Barnsley.

◆ ◆ ◆

We understand that the question of holding a " Glass Convention " in 1927 is now being discussed and that the proposal has been very favourably received.

◆ ◆ ◆

It is stated that at the request of the Glass Manufacturers Association, the Czecho-Slovakian Government has decided to refuse passport visas to skilled glass-makers who wish to emigrate. So far the glass workers union has taken no action.



MODEL KFO.

LATEST MILLER FEEDER

PROGRESSIVELY
DEVELOPED
SINCE 1907.

WILLIAM J. MILLER, INC.
SWISSVALE, PA., U.S.A.

London Office: 366 STRAND, LONDON, W.C.2 Tel. No.: REGENT, 5647.
Cable Address AUTOGLASMA, RAND, LONDON & AUTOGLASMA, PITTSBURG, PA.

Now Ready!

Volume II

Industrial Furnaces

By

W. TRINKS, M.E.

Fuels, Furnace Types and Furnace Equipment; Their Selection, and Influence Upon Furnace Operation.

The ONLY BOOK *in* ENGLISH *available on this important subject.*

405 PAGES. 292 FIGURES.
27/6 net (VOL 1, 22/6 net)

GLASS PUBLICATIONS LTD.,
TALBOT HOUSE,
ARUNDEL STREET, STRAND,
LONDON, W.C.2.

MOULDS

YOU ARE BOUND to improve the quality and output of your bottles and jars if you use **GOOD MOULDS.**

We supply moulds having the highest possible workmanship and finish. They are produced from the best crucible chilled castings and are machined throughout to precision gauges by practical mouldmakers.

Our service of quick deliveries and guaranteed accuracy in all respects is backed by **LONG PRACTICAL EXPERIENCE.**

We specialise in mould equipment for **LYNCH, MILLER and O'NEILL** automatic machines but any and all types of moulds are undertaken.

No Order too Large. No Order too Small.

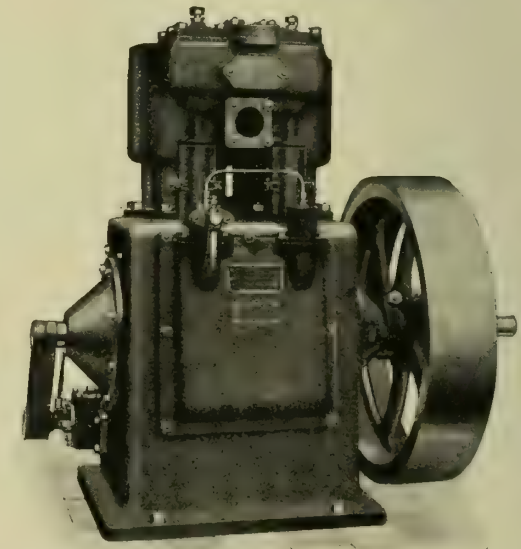
We also supply Glassworks patterns and crucible iron castings of all descriptions.

JOHNSON RADLEY & SONS, Ltd.,
Chesney Works,
Hunslet, Leeds.

Telegrams—
MOULDS, LEEDS

Telephone—
LEEDS **21354.**

"BROOMWADE"



AIR COMPRESSORS
BRITISH AND BEST
FOR ALL DUTIES.

BROOM & WADE, Ltd., HIGH WYCOMBE.

admixed with the minimum possible amount of plastic binding clay, stamped *in situ,* with a superficial 2-inch layer of sillimanite or andalusite material bonded with 8 per cent. of ball-clay. This potsherd mixture was also recommended for patching up openings that had appeared in a siege in the course of working.

Another feature demanding the careful attention of the purchaser, is the design of the glass pocket, and one very suitable design was described, having a ternary air inlet, providing for sufficient combustion of the gas passing towards the main secondary air stage. The pocket was thus kept at a suitable temperature, enabling it to be emptied in a few minutes.

A self-contained furnace with step-grate producers was considered favourably, on account of its simplicity, low initial cost, and maintenance cost, as compared with a producer plant built away from the furnace. The latter plant was capable of the production of better gas, but entailed a considerable amount of labour and precaution in working. The step-grate producer built in close conjunction with the furnace was quite efficient.

Pot failures were classified as due to :—

(1) The composition and nature of the pot clay mixtures, their manufacture and annealing.

(2) Faulty furnace operation or design.

(3) The method of treatment of the pot and to the shape or design of the pot itself.

In view of the numerous data published on the composition of pot clay mixtures, the author merely pointed out that recuperative furnace practice called for a higher proportion of grog.

Among the many factors responsible for pot failures in the second class, the admission of excess free air into the furnace was placed first. This might occur following upon difficulties met with in emptying glass pockets, or due to insufficient gas, as a consequence of inaccessible obstruction in the gas mains. Excessive stack draught was also a cause of trouble; recuperative furnaces responding better to an increase on the secondary air and gas supply than to an increase in the main draught.

Considering the effect of furnace design, narrow air and gas ducts were found to subject the pots to local heating, and larger ducts and ports were preferred. The smaller the furnace, the greater is the risk of the loss of heat during pot setting.

The author was inclined to sacrifice the advantage of tapered pots in apportioning more of the batch in the zone of greatest heat in the furnace, to the greater security in pot life attendant upon the use of the vertical-sided pot.

Several members took part in a lively discussion, in the course of which Mr. M. H. Edwards testified to the keen desire of the pot-makers to help the glass manufacturers, adding, " We get more worry over the glass-house pots than everything else put together, and yet they form only 5 per cent. of our business."

Two other papers had to be taken as read, owing to the lack of time. They were :—

(a) **" The Effect of Chlorides on the Melting and Working of Potash-Lead Oxide-Silica Glasses,"** by Edith M. Firth, B.Sc., F. W. Hodkin, B.Sc., Constance M. Muirhead, B.Sc., M. Parkin, M.Sc., and Prof. W. E. S. Turner.

(b) **" The Production of Opalescence by Chlorides in Potash-Lead Oxide-Silica Glasses,"** by Edith M. Firth, B.Sc., F. W. Hodkin, B.Sc., Constance M. Muirhead, B.Sc., and Prof. W. E. S. Turner.

THE NEXT MEETING—SHEFFIELD, APRIL 21st.

The Annual General Meeting of the Society will be held in Sheffield, on April 21st, when the election of Officers and Members of the Council will take place.

Mr. W. Butterworth (Senior), of Messrs. Butterworth Bros., Ltd., Manchester, is the President designate.

Several papers of interest are to be presented, dealing with the following subjects :—

(1) The examination of pots, etc.

(2) The devitrification of lead borate.

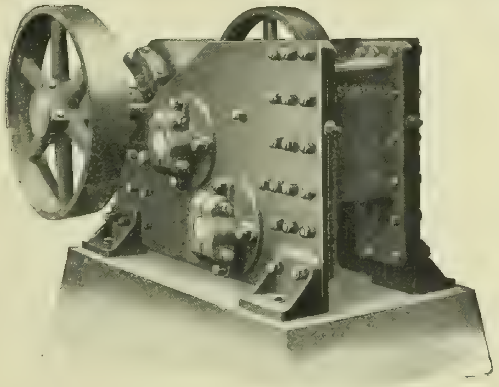
(3) The qualitative determination of selenium in glass.

(4) The purification of sand.

V. D.

* * *

During 1925 the United States consumption of polished plate glass was 135,000,000 sq. feet of which about 16,000,000 sq. feet were imported.



For Breaking down Glass Cullet

the Sturtevant Roll Jaw Fine Crusher is the ideal machine. It can be adjusted to give a coarse or fine product, and the mechanism ensures smooth running, slow speed, and the minimum of power.

Write for free leaflet G.L. 1541.

STURTEVANT ENGINEERING Co. LTD.
149 QUEEN VICTORIA ST LONDON E.C.4

New DEVELOPMENTS in
GLASS FURNACES:

TEISEN New Wasp-Shape continuous Tank Recuperative Type

with longitudinal travel of flame. The most up-to-date Machine Tank, possessing Stream line features and securing:

HIGH EFFICIENCY
LONG LIFE
CONSTANCY OF TEMPERATURE
EASY MEANS OF REGULATION
GOOD ACCESS TO REPAIR TO THE THROAT

TEISEN New T Shape Cross Flame Tank Regenerative Type

For the largest capacities securing:

HIGH OUTPUT WITH ECONOMY OF FUEL

by better utilisation of the flame. Designed on the principle of the Modern Open Hearth Furnace.

LET ME STUDY YOUR PROBLEMS.

Individual Attention to all Furnace Matters.

Write Now—

Th. TEISEN, C. E.
Furnace Engineer,
20a, Temple Street,
BIRMINGHAM.
'Phone—Central 1806. *Cables*—TETE, BIRMINGHAM

AIR COMPRESSORS & VACUUM PUMPS

As Illustrated in 5 sizes from 10 to 80 cubic feet per minute

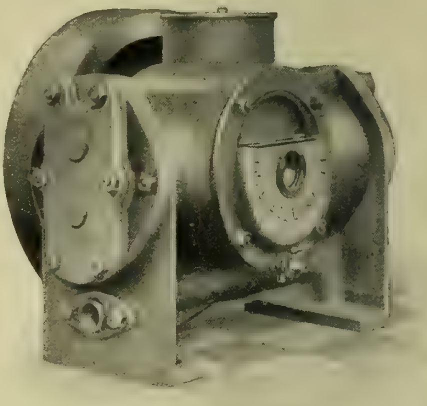
—

Other types
Larger sizes

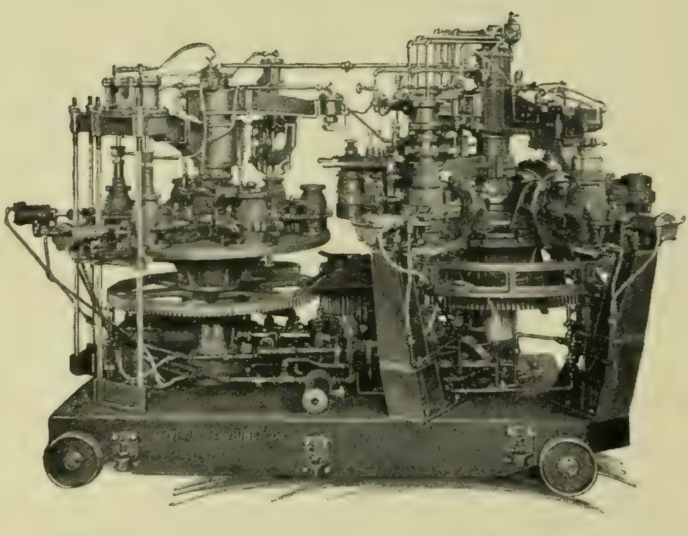
—

Any Pressure or Vacuum

—



LACY-HULBERT & CO., LTD.
BOREAS WORKS, BEDDINGTON
NR. CROYDON, SURREY
Telephone: CROYDON 1698.



The New O'Neill No. 44 Blowing Machine.

A well built, high speed blowing machine with a range from 6 oz. to 40 oz. in capacity. Operating speeds up to 23 per minute depending on the class of ware being made. Have our London representative give you the details.

THE O'NEILL MACHINE CO.,
TOLEDO, OHIO, U.S.A.

LONDON OFFICE: 10 SAVOY ST., STRAND, LONDON, W.C.2.

The Use of Compressed Air—*Continued.*

By ROBERT WILSON.

Real Volumetric Efficiency. The product of the results obtained for "apparent volumetric efficiency" and "the reduction of volumetric efficiency due to initial heating," will show the actual volume of air dealt with at atmospheric temperature only, and still leaves the volumetric losses due to low suction pressure and leakage to be recognised. These, it was decided, could be assumed to be 1.5% and 1% respectively. Real volumetric efficiency, therefore, can now be estimated.

	Pressure per sq. in.	
	40 *lb.*	100 *lb.*
(1) Apparent volumetric efficiency, from example (4) is	·9205	.8186
(2) The reduction due to initial heating from example (7) is	·963	·9285
(3) The reduction due to low suction pressure as above is	·985	·985
(4) The reduction due to leakage as above is	·99	·99
Therefore "real" volumetric efficiency is the product of these = say	.87	·74
or	87%	74%

These results mean that of the total piston displacement volume only 87% and 74% is delivered from the cylinder when the terminal pressure in the cylinder is 40 lb. and 100 lb. per sq. in. respectively.

It will be appreciated that these are theoretical values, and that approximate figures only can be obtained by the methods used. The results, however, are a good indication of those to be expected from a compressor on the test-bed—which is, of course, the only method by which they can be ascertained definitely. It will be apparent, however, that the compressor, when tested for capacity, must deliver continuously at the specified working pressure. The method of measuring the volume delivered while the pressure is raised from a lower to the working pressure does not reflect the full extent of the losses which occur under working conditions. The volume of free air delivered and the power required to drive the machine are the two principal standards by which air compressors should be compared, and although the results shown above are approximate only, they should prove a useful guide to the user when he has such a task in hand, and more especially if the machines he is comparing include any for which piston displacement only is given. Some idea of volumetric efficiency is necessary when piston displacement only is given, and although the practice of rating compressors on the volume of free air actually delivered is now much more general, the results given above, together with those which can be obtained from the diagram in Fig. (8) may still prove serviceable to the user.

Fig. (8) shows a diagram from which can be obtained the volumetric efficiency for different clearance ratios and different air pressures. The curves have been calculated by the methods used for the theoretical computations given above, and for single-stage compression only.

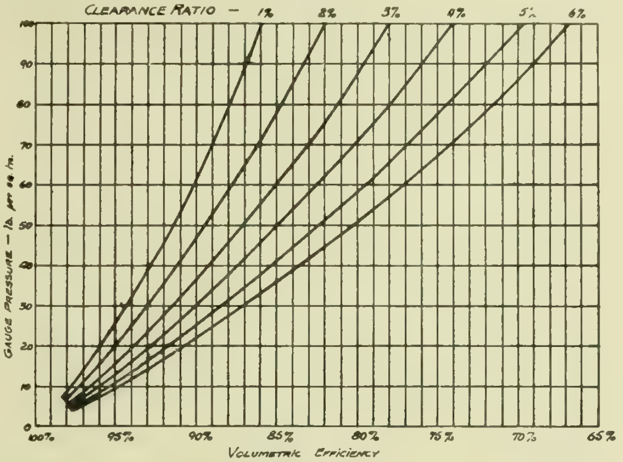


Fig. 8.

Final temperature of compression. It is interesting here to note the effect of initial temperature on the final temperature of compression. Wheras in example (5) the intial temperature was taken as equal to that of the atmosphere, viz. 60° F, example (7) showed that this temperature was more likely to be about 80° F and 100° F, when the terminal pressure was 40 lb. and 100 lb. per sq. in., respectively. The maximum cylinder temperature with these initial temperatures can be calculated from equation (8), assuming adiabatic compression.

$$\text{Equation (8) } T_2 = T_1 \left(\frac{P_2}{P_1}\right)^{\frac{1\cdot4-1}{1\cdot4}}$$

$$\text{than } T_2 = 540\left(\frac{54.7}{14.7}\right)^{\cdot29}$$

$$= 790^\circ \text{ F. absolute or } 330^\circ \text{ F.}$$

................(40 lb. pressure)

$$\text{and } T_2 = 560\left(\frac{114.7}{14.7}\right)^{\cdot29}$$

$$= 1014^\circ \text{ F. absolute or } 554^\circ \text{ F.}$$

................(100 lb. pressure)

These results show an increase over the results obtained in example (5) of 28.5° F and 70° F respectively, the increase being due to the initial heating of the air prior to compression, and indicate that the maximum temperature in the cylinder is higher than the theoretical adiabatic values calculated with T_1 equal to atmospheric temperature. It is principally on account of this high initial temperature that multi-stage compressors are preferable for pressures over 60 lb. per sq. in., as, with single-stage compression, apart from the high volumetric loss, the final temperature of compression generally is too high to permit of proper lubrication of the piston and cylinder.

(To be continued.)

Coloured Glass and Glass Decoration.

(*Continued from page 181*).

printing names and instructions upon small bottles and containers.

Another method which can be carried out at a lower temperature is to print or write with a paint made by grinding 2,000 parts of boric acid with 50 parts gum Arabic; when dry, this can be heated to about 200° C., when the gum is volatilised and the boric acid fuses to the glass to which it adheres firmly.

In the foregoing articles the writer has attempted to draw attention to the more attractive and interesting aspect of glass production.

At the present time the industries of the world, particularly the British industries, are in the melting pot, some to emerge in a form more suited to the changed conditions of the day, some never to be seen again.

There is a danger that the production of British high class glassware may fall into the latter category. Certainly the old conditions under which the flint glass craftsmen were trained cannot be repeated. The boy, instead of commencing what was little less than a life of slavery at eight or nine years of age, now enters the glasshouse at sixteen with all the ideas of a man. These new and improved conditions must be met by real intensive training on properly organised lines, taking advantage of all that chemistry and physics has placed at the disposal of the glass maker.

PUBLICATIONS RECEIVED.

Road Risks Illustrated. The 1926 edition of this extremely useful and interesting handbook has just been issued by the Royal Insurance Company, Ltd., 1, North John Street, Liverpool. By means of excellent photographs, many accidents of an unusual character are shown, whilst statistics of the causes of accidents are given, together with a summary of the legal points which motor owners should know. Readers may obtain copies on application to the Company.

A Picture Book of English Glass. This booklet, which is published by the Authorities of the Victoria and Albert Museum, South Kensington, London, S.W.7, in conjunction with the Board of Education, forms one of a series being prepared dealing with some of the examples of old English craftsmanship which are to be seen there.

By means of twenty excellent photographs and brief descriptive matter, the period from the late 16th century to the early 18th century is covered, the illustrations being chosen as representative of the different stages in the development of glass craftsmanship in this country. It is interesting to note that four of the examples chosen have been presented to the Museum by Mr. Francis Buckley, whose name and work is well known to the majority of our readers.

The booklet can be obtained directly from the Museum, price 6d. (by post 7d.).

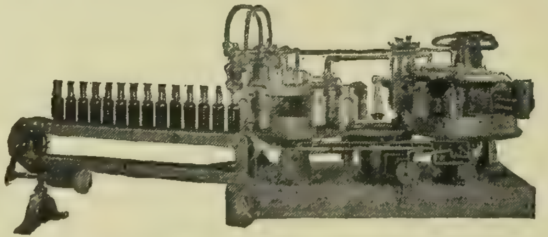
DEFECTS IN GLASS

By Dr. C. J. PEDDLE, M.B.E., F.I.C.

In response to numerous requests we propose publishing in book form this series of articles. They are being entirely rewritten with additional illustrations, and will be published at a popular price.

GLASS PUBLICATIONS LTD., TALBOT HOUSE, ARUNDEL ST., STRAND,——LONDON, W.C.2.

AUTOMATIC



May be Worked on Floor Level—No Pit Needed

NARROW NECK AND WIDE MOUTH
BOTTLE BLOWING MACHINE
No Transfer Boy. No Take-Out Boy.
STRICTLY AUTOMATIC
When Operated with Mechanical Feeding Device.
Can be Worked by Hand Gatherers. Speed 10 to 32 Bottles per minute, ranging in size from ¼ oz. to Gallon
LYNCH GLASS MACHINERY COMPANY,
ANDERSON, INDIANA, U.S.A.
Cable Address—"LYNCHNOBOY" ANDERSON
Codes—A.B.C. 5th EDITION, BENTLEY'S, WESTERN UNION

The Source of the Coloured Glass used in Mediaeval Stained Glass Windows.

By JOHN A. KNOWLES.

(*Continued*).

In the Normandy glass works the schools of glass-painting in the South of England had at their very door a source where they could draw their raw material. To fetch glass thence was a natural thing to do, when ships were continually crossing to Normandy to obtain Caen stone for the carvers and sculptors of our cathedrals. There can be but little doubt that frequently glass and stone were carried in the same bottom.

In 1317 we find Exeter Cathedral purchasing " 639 paice (peciis) of white glass bought at Rouen. £15 14s. 9d." (Exeter Cath. Fabric. Rolls. quoted in Britton. " Hist. and Antiq. of Cath. of Exeter," p. 91).

But the use of Normandy glass was not confined to the south. In 1508 Sir John Petty, the glass-painter, bequeathed to York Minster " vj tabyls of Normandy white glasse " and to his brother Robert he gave " a credill of Normandy glasse " (J. A. Knowles, Glass-Painter of York. " Notes ad queries " 12s. ix 64), whilst numberless other notices could be mentioned.

The above clearly shows that the English glass-painter was almost entirely dependent upon the continent for his raw material. Indeed, he was so much at the mercy of wind and waves, not to mention pirates, that a clause had frequently to be inserted in contracts making the completion of them by a certain date contingent upon the possibility or otherwise of obtaining the glass from overseas. Thus, when in 1562-3 William Blithe of Thackstead, made a contract with Trinity College, Cambridge, " for glassing the windows of the new chappell with burgundye glass " he agreed that the work should " be don betwen this and easter if passedge by sea be had before the feast of the nativitie next comyng; if yt happen that passedge be not concluded before yt feaste, but betwixt christenmas and fastingham, than or wyndowes to be glassed before pentecost next ensewyng." (Willis and Clark " Archit. Hist. of Univ. of Cambridge," vol 11, p. 572). At an early period in their history the Hanseatics had a rule that no merchants should send their ships to sea after St. Martins Day (November 11th) and that they should endeavour as far as possible to be in port by Michaelmas (September 29th), for, as an old chronicler writes " to sail after Martinmas is to tempt God." In the year 1391 a Hanseatic Diet ordained that no Hanseatic merchant should sail forth from a western to an eastern, or from an eastern to a western harbour between Martinmas and Candlemas (November 11th—February 2nd) (Zimmern. " The Hansa Towns." " Story of the Nations Series " p. 18).

In view of these facts it is remarkable that the English glass-painter always managed to carry on as well as he did, for he had much to contend with. He lived in an age when wars and rumours of wars were continual and when piracy was almost looked upon as a polite accomplishment. Ships had to sail not in single spies but in batallions and armed to the teeth, so as to be ready to protect themselves at any moment. It is therefore somewhat surprising that glass-painters were not left without glass more frequently than they were. Frequent interruptions in trade we know there were, as, for instance in 1392, when trade with Germany was practically stopped. The king had imposed enormous duties on imported goods, and the Germans retaliated by forbidding the traffic in English cloth. Previously in 1339 the French fleet, recruited from the Spanish and Genoese as well as from the Norman and Picard ports, rode supreme in the channel, descended on the southern coast, burning Portsmouth and severely injured Southampton, so that cross-channel traffic must have been at a standstill. Bruges, for long the centre mart of Europe, as we have already seen, was frequently in trouble. On one occasion it had the temerity to imprison Maximilian of Austria, whose escape planned by the court jester was so romantically frustrated by the swans on the canal. The city was made to pay dearly for this contempt for the divine right of kings; by having the canal by which the city was connected with the sea at Sluys, blocked up. As the result of this Bruges was deserted by the Hanseatics in favour of Antwerp. Later the whole of Flanders was laid under an interdict by the English crown in consequence of the support given by the dowager duchess of Burgundy to the imposter Perkin Warbeck. Warbeck was well received in Flanders, then ruled by the archduke Philip. As Philip, at the instigation of the duchess, encouraged Warbeck, Henry VII banished all Flemings from England. Philip replied by expelling all the English from Flanders, so that commercial intercourse between the two countries was almost entirely suspended.

This interruption in trade, as Bacon tells us "began to pinch the merchants of both nations very sore " and they besought their respective sovereigns "to open the intercourse again." Philip withdrew his support for Warbeck, so that his subsequent appearance in England was a complete failure. Lack of English wool made the Flemish rulers alter their policy, and in 1496 the treaty known as the " Intercursus Magnus " was made between the two nations. As a result " the English merchants came again to their mansion at Antwerp, where they were received with procession and great joy." Again in 1528, Wolsey, in order to gain a political end, suspended all trade with the Netherlands.

But even when the country was nominally at peace, a continual guerilla warfare was being carried on between the trading fleets of the different countries. Piracy was common and the English were just as bad as any. (Vide "Yorks. Archaeol Journal" ii. 246, for a suit in the Star Chamber between Han I Garth of Danzig and the abbot of Whitby and others, relating to the purchase of goods from a ship seized by pirates in the Humber).

A chronicler, Thomas Wykes, writing in 1264, in opposition to Simon de Montfort, tells how, when the piracy of the sailors of the Cinque Ports had put an end to trade and people began to complain, the Earl tried to persuade them that they could get on very well without trading with foreigners. (Thomas Wykes, S.A. 1264, in "Annales Monastici" (Rolls Series iv, 158).

The well-known and oft repeated story of the Fairford glass having been captured from a prize at sea, probably contains a grain of truth, though not as the story is usually interpreted. It depends what is understood by the word "glass," for if it is taken to mean the painted windows, the story without being enlarged with the additional embroidery that the church was built to fit them, is, as Westlake points out, in the highest degree improbable. The windows might, however, have been painted on glass captured in a ship bound elsewhere, and brought to Bristol. For the younger Tame, afterwards Sir Edmund, was High Sheriff of Gloucestershire in 1505, and sometime between that year and 1520, when he entertained Henry VIII at Fairford, would supply a not unlikely date for the windows. They might well be a late example of the Bristol school of glass-painting. Westlake ("Hist. of Design in Painted Glass" vol. iii p. 60). considers 1490 a not unlikely date. But there is work no more advanced in style in St. Michael le-Belfrey Ch. York, and the windows of which are as late as 1537. The story that the glass was captured at sea is not improbable in itself.

The fortunes of Memling's Last Judgment now at Danzig provide a parallel instance and give a curious illustration of the insecurity of commerce and the interruptions in trade caused by pirates and naval wars. Ordered at Bruges through the Florentine agents (the Portinari) there, probably by Julian and Lorenzo de Medici, the picture could not be carried to Florence on account of the war between England and the Hanseatic League begun in 1468. Trade was at a standstill. The English on one occasion seized a fleet of 108 ships returning to Lubeck and Riga, and the men of the Hanse retaliated by laying hands on rich English prizes. At last in 1473 the picture was sent off from Sluys in a British built ship which had been bought by English merchants as a French prize, chartered by Florentines in Bruges for a voyage to London, registered in the name of the Portinari, commissioned by a French captain, and navigated under the Burgundian flag for greater security against capture. It was, however, taken off Southampton by a privateer sailing under the Danzig flag, and commanded by a noted captain, Benecke. In spite of a bull issued by Sixtus the Fourth for the excommunication of "our beloved son, the sea-pirate Benecke," as the Pope styled him, ("Dilectus filius Polus Behenk perrata maritimus." The bull is printed in extract in notes to "Beilage of Weinreichs Chronick" p. 102). The cargo was sold at Stade and the picture brought by the owners of the ship to Danzig. (Crowe and Cavalcaselle. "Early Flemish Painters" 257-260.)

The same war must have proved a sore trial to glass-painters. They were evidently at their wits end in order to obtain glass, and had to fall back upon English glass for the whites and previously rejected pieces and scrap for the colours. This is clearly to be seen in windows of the period at York. Ruby glass in particular was evidently very scarce indeed. Some of the windows of the clerestory of St. Martin-le-Grand York, which were executed about that time, do not contain a single piece. Others only small pieces in the borders, such as would have been left over as scrap, from windows made in happier times. The most striking example as to what shifts glass-painters were reduced is to be seen in the east window of Holy Trinity, Goodramgate, York, which was executed some time previous to 1476. What ruby there is in the window is (with the exception of two very small pieces) so dark as to be nearly black. But even this poor material ran short; and one of the backgrounds which should have been cut out of ruby in order to match the other, has been carried out with a dull manganese pink. Even the white glass, no doubt English, is very inferior, and of such a quality as would previously have been considered as only fit for plain glazing. For it has taken the silver very badly and the stain instead of being a fine yellow has come out a nasty plum colour. It is perhaps also significant that about the same time we find the Dean and Chapter of York buying glass for the plain glazing of the great lantern tower windows from Brantley Butts, near Leeds. ("York Minster Fabric Rolls." Surtees Soc. s.a. 1479.)

After the fifteenth century the importation of coloured glass as an article of commerce gradually declined, and finally ceased altogether. It will not, therefore, be out of place to consider why this was so.

There is a generally accepted opinion that the glass-painters of the sixteenth and seventeenth centuries preferred the use of enamels in preference to coloured glass, with the result that the manufacture of colours gradually died out. This, however, is but half the truth, and does not take into consideration all the facts of the case. The artists of the period seem to have been perfectly well aware that it was impossible to obtain by means of enamels the brilliant colour effects that flashed and pot-metal glasses give. They changed from the mosaic to the enamel method not so much because they would as because they must. Nor did this come about suddenly. For a hundred years there was a gradual decline in the demand and hence in the supply of coloured glass, so that as time went on the number of factories producing it would become fewer and fewer. At the end of that period came a cataclysm which finally entirely wiped out the few that were left. We shall have to consider the decline and the fall of glass factories separately.

In the first place the religious upheaval of the sixteenth century, the suppression of the monasteries, and acts and injunctions against "images" in church windows, were a great blow to the craft of glass-painting and therefore to glass manufacturers as well. As fewer windows were being done less coloured glass was required, and though one cannot but deplore much that happened at the Reformation, it is obvious that had it never occurred, something must have come to give pause to the incessant making of windows. It was impossible that the stream of orders, which glass-painters had been receiving for so long could continue indefinitely.

The craft suffered from over-production. There were far more churches than were required. (York for example, with a population of between fifteen and twenty thousands, had over forty churches, seventeen chapels, sixteen hospitals, nine abbeys and monasteries, besides the Minster. In Elizabeth's reign many superfluous churches in the city were pulled down) and it would seem that most of them were already full of stained glass. (Prisden speaking of the little church of such an out-of-the-way place as Ottery-St.-Mary in Devonshire, wrote " The windows little and low are so bedecked with the arms of divers benefactors, that instead of Lux Fiat it may be verified that they are umbrated thereby." Trans. " Exeter Archaeol." Soc. i 40.)

People must have been getting tired of the endless repetition of saints and canopies which had been going on for over three hundred years or more, and no doubt longed for something different, had there been window space in which to put it. This lack of opportunity together with the injunctions against " images " (i.e. figure work) which practically enjoined glass-painters to confine themselves to ornament and heraldry, were no doubt two of the chief causes which induced many of them to forsake the calling in which they had been brought up and take to wood engraving and picture painting, as we read of artist after artist doing. The revival of classic taste in architecture then known as the " new style " which demanded a treatment in whites, browns and gold for windows, made glass-makers confine their attention to white glass instead of coloured. As a glass-painter, Rimangia remarks in a letter to the chapter of the Cathedral of Auch " They (the glass-makers) practically refuse to spend their time in making coloured glass and are not making any." (Appen p. seq.).

Glass-painters, therefore, were forced to fall back upon the enamel system on account of the difficulty of obtaining coloured glass, of which as early as the beginning of the seventeenth century there was an acute shortage. Coloured glass could no longer be regularly obtained, but in many cases where it was required to match the old, had to be specially made. Howes, in his continuation of " Stowe's Chronicle " tells us (" Opus. cit." p. 892. quoted by Dallaway. " Observ. on Eng. Architecture " p. 280) that in 1613 " all the windows of the church of St. Stephen, Walbroke, were pleasantly repaired with new colloured glasse, made only for that purpose."

And Thomas Langton, the merchant adventurer and importer of glass who has been mentioned previously, writing to the Warden of Wadham College in 1621, to recommend Bernard van Ling as a suitable artist for the east window of the college, said, " I will let you have Collered Glasse out of that wch I pvided for Poules (old St. Paul's) for I am sure there is not any to be bought in England." (Jackson, " Hist. of Wadham Coll.")

It is, of course, perfectly plain that one of the reasons for the shortage of the supply of coloured glass was the lack of demand. This is an economic law which is not confined to glass, or to any particular period. The same thing occurred in the eighteenth century.

We find the Secretary of the French Academy of Sciences writing in 1772 to recommend that Le Vieils history of glass-painting be published at the expense of the society, saying, " It is absolutely necessary that artists should know how to prepare their (enamel) colours themselves, since at present the small demand for coloured glasses has caused the manufacture to be neglected, and practically abandoned, in all the glass works. (Le Vieil. " L'art de la Peinture sur Verre " p. 18).

There was, then, so much of gradual decline, then came the fall. The final extinction of coloured glass-making as an industry of any magnitude was brought about by the wars which devastated Lorraine in 1633, and the opposition of Charles IV, Duke of Lorraine, to the armies of Louis XIII. This led a few years later to the publication on the 1st February 1636 of the " Decision of the counsellors deputed by the king for razing to the ground and demolishing the places and castles of Lorraine." This finally put an end to the manufacture of coloured glass for windows. The glass-painter, Rimangia, in the letter to the Chapter of the Cathedral of Auch, written about the year 1640, said " (You) ask us for Lorraine glass made and manufactured in the said country, but this is impossible even though a thousand times what it is worth were paid for it; inasmuch as the workmen have gone away on account of the wars in the country and all the furnaces are thrown down." He adds, however, " they (the glass-makers) had gone away into other places where they are making glass as good as was made in Lorraine." (L'abbé Caneto Sainte d'Auch." Roy. fol. 1857. pp. 69-70.)

This was no doubt true of one or two cases, as we shall see, but years of enquiries in many directions failed to discover where the glass-makers had gone to. At the same time it is impossible to suppose otherwise than that much in the way of tradition and practice was irrevocably lost.

(*To be continued.*)

Vitreous Enamel Colours.
Stains for Glass.
Oxides for Colouring Glass Metal.
Selenium Metal.
Selenate and Selenite of Soda.

GROUND BONE. FELSPAR, FLINT, FLUORSPAR, QUARTZ, STONE, WHITING, ETC.,
CARBONATE & SULPHATE of BARYTES
OXIDES OF ANTIMONY, ARSENIC, CHROME, COBALT, SMALTS, COPPER, IRON, MANGANESE, NICKEL, TIN, TITANIUM, URANIUM, ZINC, ETC
TRADE CERAMIC MARK
WENGERS, LTD.
CERAMIC COLOURS & CHEMICALS
ETRURIA.
STOKE-ON-TRENT.
England.
COLOURS, FOR POTTERS, GLAZED BRICK MANUFACTURERS, & GLASSMAKERS.
Samples & Price Lists Sent on Demand.
PREPARED ENAMELS FOR CAST & SHEET IRON, COPPER & JEWELLERY,

Limespar.
Phosphate of Lime.
Nitrate of Soda.
Nitrate of Potash.
Opavetro for Opacifying Glass.
Alumina, Oxide and Hydrate.

The New Government Bill: Glassware to be Branded?

(By OUR CITY CORRESPONDENT.)

While the last isue of GLASS was actually in the press containing my reference to the Merchandise Marks question, the Government's new promised Bill was laid on the table at the House of Commons. We can therefore now dismiss from our mind all surmises as to the trend of the Government's intentions and examine the Bill itself. Of this, for convenience I give the following summary:—

Section 1 of the Bill reads as follows:—

"It shall not be lawful to sell, expose for sale, or distribute by way of advertisement, in the United Kingdom, any goods which bear any name or trade mark being, or purporting to be, the name or trade mark of any manufacturer, dealer or trader in the United Kingdom, not being goods produced or wholly or mainly manufactured therein, unless the name or trade mark is accompanied by an indication of origin."

Section 8. "Indication of origin" means, at the option of the person applying the indication, either

(a) in the case of goods manufactured or produced in any foreign country, the words "foreign manufacture" or "foreign produce" and in the case of goods manufactured or produced in a part of His Majesty's Dominions outside the United Kingdom the words "Empire manufacture" or "Empire produce"; or

(b) a definite indication of the country in which the goods were manufactured or produced;

the indication being given, in either case, in a conspicuous form:

From Section 2 and onwards the Bill lays down a scheme under which special marking regulations may be imposed. The subjects dealt with are

(a) agricultural produce and foodstuffs.

(b) manufactured goods generally.

Section 3. It is proposed that there shall be two small standing committees,

(a) the Agricultural Produce Committee appointed jointly by the Board of Agriculture and Fisheries, the Home Office and the Secretary for Scotland, to hold enquiries relating to agricultural and horticultural produce and the produce of any fishing industry.

(b) a Committee appointed by the Board of Trade to hold enquiries relating to goods of any other kind.

Each is to consist of not less than three nor more than five persons, who will be paid.

Section 2. These Committees, after investigations, will recommend the Board of Trade from time to time as to the particular classes of goods required to be marked with an indication of origin before they are imported (foodstuffs only), sold or exposed for sale in this country; and the Committees will decide in what manner such goods must be marked, or where, by reason of the nature of the goods, it is not possible to mark them, the means by which the goods shall be made distinguishable, e.g., by colouring or other variation in their make-up.

Section 5. On receipt of such recommendation, the Department may move for the promulgation of an Order in Council applying to such goods which, in the absence of Parliamentary veto, may operate from a date not earlier than three months from the publication of the Order.

In the case of foodstuffs, the Committees shall report whether the goods are to bear an indication of origin at the time of importation or of exposure for sale wholesale. If they are required to be marked on importation and are not so marked, importation will be prohibited under Section 16 of the principal Act.

In the case of manufactued goods the Bill does not seem to propose that any of the new regulations shall apply to goods on *importation*.

Section 4 (1), Section 8 (3). It is expressly provided that a wholesale dealer may sell goods (other than foodstuffs) wholesale to a purchaser unmarked, *provided* he secures from the purchaser an undertaking in writing that they will either be marked before they are offered for further sale, or that they will be exported or sold for exportation. This apparently is designed to assist the entrepôt trade.

Section 4 (2). The Bill requires that when advertising or offering for sale imported goods as being of a particular brand, an indication of the origin of the goods shall appear in the advertisement or offer. This does not apply to general trade catalogues or price lists, and a year's grace is given for advertisements printed or constructed before the Order was made.

Section 4 (4). Samples must also be marked, or a letter accompanying them indicating origin.

Section 4 (3). Imported parts of an article manufactured here must, if they come under an Order, be marked, provided they form a "distiguishable part" of the whole article, and are "reasonably capable" of having a mark applied.

Section 8 (1). If after importation goods undergo a "substantial change" by reason of a manufacturing process applied to them within the United Kingdom, they will not come within the Act.

It will be seen at once that the Bill does not go so far as some of the keen advocates of Merchandise marking would desire. In the case of manufactured articles, for example, it does not make obligatory the branding of articles prior to importation. They may pass into the possession of the wholesaler unmarked (i.e. of course, provided they do not infringe the terms of the Merchandise Marks Act of 1887). The object of this concession appears to be to give the wholesaler an opportunity of doing re-export trade without the handicap of disclosing the foreign origin of the goods he is selling in overseas markets. In practice, however, it is doubtful whether this concession amounts to much, since there must be very few classes of goods which could conveniently be branded elsewhere than at the place of manufacture. One could hardly imagine a wholesaler successfully offering goods to his retail customer with the stipulation that the retailer must himself mark them before sale.

Another surprising feature of the Bill is the novel requirement in regard to advertising. This means in effect that all newspaper advertisements which include offers of any class of goods that may fall under the new marking Orders will have to contain a specific note as to which, if any, of the goods so offered are imported goods. There is no doubt that a great deal of criticism will centre upon this provision, since one can foresee the complicated task it might impose, say, upon the miscellaneous advertisements of the big departmental stores.

On the 23rd March the China and Glassware Section of the London Chamber of Commerce held a meeting to consider the provisions of the Bill and unanimously passed the following resolution :—

> "That this Section, which includes in its membership the large majority of the China and Glass Merchants of London, strongly urges H.M. Government not to proceed with the Merchandise Marks (Imported Goods) Bill which threatens fresh vexatious interference with trade and has no general public demand behind it. It is pointed out that in so far as a desire exists to secure that home manufactured goods shall be identified as such, our British manufacturers can mark their own products; whereas the present Bill introduces new principles of procedure which will create endless technical complications and constant business uncertainties and may seriously injure both home and entrepôt trade."

The Section has not traditionally been entirely opposed to Merchandise marking. Some years ago it passed a resolution in favour of the marking of imported pottery under the glaze, but very strong opposition is raised to the prospect of any regulations which would require the marking of all glassware. Quite a number of glass articles would certainly be disfigured if they were required to be marked conspicuously.

It is true, of course, the Bill might become law without its main provisions ever being applied to glassware, since the Board of Trade Committee, if the Bill was set up, might not consider glassware a suitable subject for such restrictive regulations. On the other hand whatever class of goods he handles the importer cannot afford to ignore the passage of a bill of this kind, since once it becomes law he will be at the mercy practically of a small Board of Trade Committee against whose decision there will be no appeal. It is true that technically speaking Parliament has a veto, but the only way this veto could be exercised would be by the House of Commons being sufficiently aroused by the specific matter in question to petition the Crown to cancel the Order. No one supposes the House of Commons would deem of sufficient interest any specific Order relating to an individual class of goods. Consequently the Board of Trade Committee would be absolute in its powers.

I will only add that there is one other proviso laid down (in Section 5 of the Bill) which may be thought even more objectionable, i.e., the Board of Trade itself may vary the terms of the Order from time to time at discretion without referring the matter back to the committee of enquiry. The committee after hearing evidence might have decided that certain articles of glassware should be marked in a particular way. The Bill would allow the Board of Trade to step in at some later date and alter the method proposed without the traders or manufacturers concerned having the right to appeal again to the committee which has heard the evidence. This does not seem reasonable, and is almost certain to be objected to in Parliament when the Bill comes up for consideration.

The position at the moment is that the second reading has been deferred. It was due on March 15th, but cannot now take place until the middle of April. Meanwhile trade conferences are taking place in different parts of the country. The Board of Trade no doubt is not sorry to allow a little delay, so as to gather some impressions as to the reception accorded the proposals by the varied interests concerned in it. From this point of view it may be regarded as a "kite." On the other hand, whatever the hostility, the Board of Trade has put itself in rather a difficult position by introducing the Bill if it cannot subsequently go on with it. At the present moment there are some signs that dissatisfaction will be general. It is not merely the merchants who dislike the Bill, but a very large number of important manufacturing groups are equally opposed to it. The reasons for opposition are not always the same, but they have equal importance, in so far as they will be reflected in Parliamentary opposition.

Key Industries. It is possible that the fate of the Key Industries Duties will be known by the end of April, when the Chancellor is expected to make his Budget speech. A committee of seven has been sitting behind closed doors at the Board of Trade for the purpose of reviewing the present schedule. I understand that this committee has not been receiving deputations, but has been devoting its attention to the examination of such representations as have been put forward in writing. There was one recent exception to this rule. It arose out of the very complicated difficulties of the Chemical Schedule. But so far as my information goes, no glassware organisations have been interviewed, neither have their views been elicited except in writing. The committee includes Sir Wm. Pope, Sir Richard Glazebrook and Sir Arthur Colefax, as well as another Government scientist, and the heads of the principal Board of Trade and Customs Departments concerned in the administration of the duties, and it is presided over by Sir Burton Chadwick, who is Sir Philip Cunliffe-Lister's first lieutenant. It seems likely that substantial modifications may be made in the schedule so far as it affects chemicals, but I have not learnt of any important alterations that are likely to affect the glassware clauses.

At the seventh annual dinner of the British Lampblown Scientific Glassware Manufacturers' Association, held in London, on March 25th, some remarks were made by Mr. Percy Ashley (of the Industries and Manufactures Department of the Board of Trade), which seem to support the forecast of continued key industry protection for this section of the industry. Mr. Ashley said that he attached great importance to the association as an organ for the expression of the needs and views of the industry, to which the Government could refer from time to time. He said that in the present instance, where collective information had been sought on the question of the working of the Key Industries Duties, valuable assistance had been rendered, and that although he could not speak of the intentions of the Government, he could say that a better report could not have been submitted than that of the committee appointed by the association. He went on to say that the industry had within the last seven years overcome the prejudice which had previously existed in favour of foreign-made scientific instruments, and had established a very high reputation for the quality of its goods.

Safeguarding of Industries. Safeguarding machinery has slowed down very markedly since last December. Once again, through the Safeguarding of Industries Committee Conservative party in the House of Commons, the Stourbridge manufacturers have been pressing their claim for consideration. It does not seem likely, however, that the department will alter its attitude, although I am told that trade is very bad on the North-East Coast in the pressed-glass section, a large number of furnaces being out of action and others working on short time, while in two or three works the shifts have been reduced. The demand for "pyrex" however continues to be brisk.

The following extract from the official Parliamentary Report of Tuesday, March 23rd, may be of interest to the trade :—

> "**Glass-Making Industry.** *Sir Robert Gower* asked the President of the Board of Trade whether he is aware that Messrs. Ackroyd and Best, Ltd., glass-makers, claim that a promise was given in or about the year 1914 by His Majesty's Government that, in the event of their building and equipping works for the making of heat-resisting glass suitable for miners' safety lamps, a certain number of years' clear protection as against all foreigners would be given to them as from the termination of the war; and whether he proposes to take any, and, if so, what steps to carry this promise into effect?
>
> *Sir B. Chadwick* : A promise was given in 1914 that, provided English maufacturers were able to supply a sufficient number of suitable glasses, no flame safety-lamp glasses manufactured in Germany or Austria would be approved for use in the United Kingdom for a period of at least three years from the termination of the war. Further explanation of the matter was given in the memorandum attached to the Coal Mines (Temporary Provisions as to Safety Lamps) Bill, which was introduced in 1922, a copy of which I am sending to my hon. friend. No lamp glasses of German, Austrian or Czecho-Slovakian origin submitted during the period covered by the promise were in fact found to be suitable for approval.
>
> "*Sir R. Gower* asked the Minister of Labour the number of men out of employment in the glass-making industry in this country?
>
> "*Mr. Betterton* : The number of insured workpeople classified as belonging to the glass-making industry in Great Britain recorded as unemployed at 22nd February was 5,617."

THE SOCIETY OF GLASS TECHNOLOGY.

We give below a copy of an appeal that has been sent to all members of the Society. At the present time, the value of the work it has done and is doing is too well known to require further emphasis and we sincerely hope that those of our readers who are not already members will take the first opportunity of joining.

Dear Fellow Member,

It is not often that opportunities for direct service to the Society come your way but occasion has arisen to enlist the help of every member.

The Annual Report and Balance Sheet show a loss on the year's working of about £118, due in very large measure to the increasing size of the Journal, and as it is not in the interest of the glass industry that the Journal should be curtailed, it is essential we should increase the income of the Society.

We would like you to examine carefully the Society's Balance Sheet. If you will do so, you cannot fail to realise how small are the running expenses. The Society pays no rent for its offices or library; the work of the Secretary and Editor is clear of any charge whatever to the Society; the only administration charges are for a half-time Assistant Secretary and part time typist. Nearly all of the income, therefore, is absorbed in charges for meetings away from Headquarters, printing and stationery and cost of the production of the Journal, the last named item being estimated at about three-fourths of the Society's revenue.

Methods of increasing the income whereby to meet the growing cost of the Journal are receiving the earnest attention of the Council. We might raise the annual subscription which, compared with other scientific societies is low, but this is the last step the Council desires to take. By far the best solution is to obtain a substantial increase in membership and it is in this connection that you personally can help.

We accordingly enclose two application forms for membership, one for Ordinry, the other for Collective membership applying, the former to individuals, the latter to firms. If every member of the Society would at least get one new member, the resources of the Society would be greatly strengthened and its possibilities for service enlarged.

May we have your help?

Yours sincerely,

(Signed) T. C. MOORSHEAD, President.

W. E. S. TURNER, Hon. Secretary

February Trade Returns.

IMPORTS OF GLASS AND GLASSWARE.

		Quantities.				Value.			
		Month ended February.		Two months ended February.		Month ended February.		Two months ended February.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)	value	—	—	—	—	4,693	6,479	9,937	11,794
Glass Tubing and Rod for all purposes	cwts.	386	580	1,217	1,262	1,128	1,814	3,685	3,825
Illuminating Glassware	,,	8,944	11,657	23,102	27,193	24,248	34,957	65,104	78,889
Machinery Glassware	,,	21	10	29	15	259	133	416	174
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	39.508	44,776	84,623	93,017	108,454	123,756	230,973	252,218
Plate and Sheet Glass	,,	85,469	100,542	177.311	203,191	124,465	141,426	268,164	267,136
Optical Glass (other than worked Elements, *e.g.* Lenses)	,,	5	2	13	5	221	215	758	304
Bottles and Jars	gross	93.542	117,672	199,321	229,167	55,250	72,699	121,909	138,732
Glass and Glassware not elsewhere specified	cwts.	1,058	2,373	2,383	5,294	4,919	6,490	8,950	14,067
Total Value	£	—	—	—	—	323,637	387,969	709,896	767,139

EXPORTS OF GLASS AND GLASSWARE (BRITISH PRODUCTS).

		Quantities.				Value.			
		Month ended February.		Two months ended February.		Month ended February.		Two months ended February.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)	value	—	—	—	—	5,510	5,593	12,824	11,889
Tubing and Rod for all purposes	cwts.	210	498	804	805	1,820	2,699	5,307	4,538
Illuminating Glassware	,,	454	466	915	856	4,151	3,946	9,502	7,623
Machinery Glassware	,,	372	176	726	471	2,660	1,370	4,763	3,422
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	2,635	2,225	5,149	4,218	24,033	22,707	44,690	41,497
Plate and Sheet	,,	71,066	88,934	138,894	170,165	140,598	154,658	285,146	303,021
Optical (other than worked Elements, *e.g.* Lenses)	,,	6	4	22	6	226	91	691	121
Bottles and Jars	gross	25,725	29,497	46,979	48,373	25,405	30,329	48,676	50,683
Manufactures, not elsewhere specified	cwts.	538	844	1,071	1,657	3,339	4,341	5,857	9.584
Total Value	£	—	—	—	—	207,742	225,734	417,456	432,378

EXPORTS OF GLASS AND GLASSWARE (FOREIGN AND COLONIAL MERCHANDISE).

		Quantities.				Value.			
		Month ended February.		Two months ended February.		Month ended February.		Two months ended February.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)	value	—	—	—	—	526	477	1,048	778
Glass Tubing and Rod for all purposes	cwts.	1	2	2	3	12	29	25	48
Illuminating Glassware	,,	142	154	370	299	1,424	1,292	2,844	2,405
Machinery Glassware	,,	—	2	—	2	6	26	6	26
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	791	503	1,382	1,088	4,224	3,217	8,214	6,571
Plate and Sheet	,,	403	207	599	907	419	351	729	878
Optical Glass (other than worked Elements, *e.g.* Lenses)	,,	2	—	3	3	67	4	75	19
Bottles and Jars	gross	1,367	1,054	3,893	1,921	1,277	1,087	3.723	1,786
Glass and Glassware not elsewhere specified	cwts.	73	102	118	110	934	319	1,337	419
Total Value	£	—	—	—	—	8,889	6,802	18,001	12,930

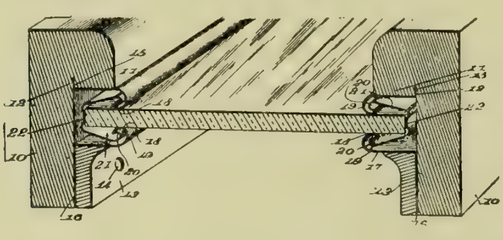
United States Patents.

GRANTED FEBRUARY 9, 1926.

1,571,985.—**Machine for Grinding Glass Plates.** Karl A. Weber, Los Angeles, California. Filed March 18, 1924. Serial No. 700,035. 9 Claims. (Cl. 51—76.)

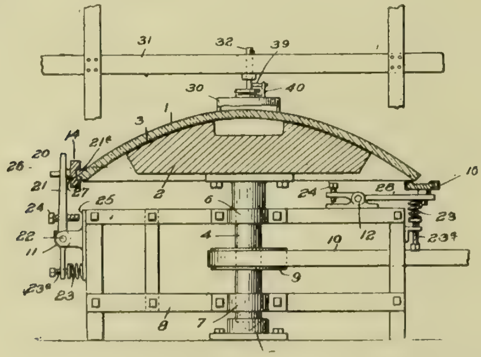
1. A machine for grinding an edge of a glass plate comprising a line of support upon which the glass may be stood on edge in a substantially vertical position, means for guidingly maintaining it in such position, and grinding means moving in the line of feed of the glass and located substantially on a level with said line of support and onto which the glass moves and by which it is supported on edge while being ground.

1,572,427.—**Mounting for Window Glass.** Mzl Fuller, Chattanooga, Tenn., assignor to Fuller Automobile Company, Chattanooga, Tenn., a Corporation of Tennessee. Filed November 17, 1923. Serial No. 675,371. 3 Claims. (Cl. 296—44.5.)



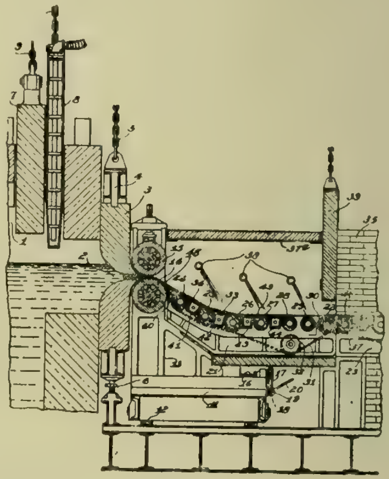
3. A mounting for window glass having yieldably mounted side bearing surfaces and a yieldable edge bearing surface connected to and carried by the side bearing surfaces, said edge bearing surface and said side bearing surfaces being connected in such manner that when one of the surfaces yields the others will be pressed more firmly into engagement with the glass by virtue of the yielding movement.

1,572,451.—**Apparatus for Finishing Reflector Blanks.** William H. Taylor, Ford City, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed June 5, 1922. Serial No. 566,202. 2 Claims. (Cl. 51—3.)



2. In combination in apparatus for finishing circular glass blanks, a table or support, means for securing the blank to be finished to such table or support, idler grinding devices arranged around the periphery of the table or support, means causing such devices to press against the edge of the blank, an annular cutter with its axis concentric with the axis of the table or support engaging the surface of the glass, and means for causing the table and grinding devices and cutter to rotate relatively to secure a cutting action between said grinding devices and annular cutter, and the glass blank.

1,572,468.—**Apparatus for Making Sheet Glass.** Robert L. Clause, Sewickley, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed May 13, 1925. Serial No. 29,932. 4 Claims. (Cl. 49—33.)

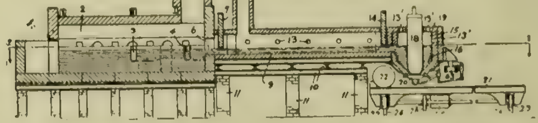


1. Apparatus for forming sheet glass continuously in a sheet or ribbon from a body of molten glass, comprising a pair of cooled rolls contacting with said molten body of glass, and a table for receiving the glass and forwarding it, comprising a series of spaced rollers, a series of platens interspersed between the rollers having their upper surfaces substantially flat and filling the spaces between the rollers, and means for cooling the rollers and platens.

1,572,481.—**Gate for Glass Tanks.** Halbert K. Hitchcock, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, a Corportion of Pennsylvania. Filed Feb. 16, 1924. Serial No. 693,248. 7 Claims. (Cl. 49—55.)

1. The combination with a melting tank having an outlet at its forward end, of a gate mounted for vertical movement through the top of the tank, and adapted when lowered to cut off the flow of glass to said outlet, said gate comprising a lower water cooled portion and a portion of refractory material lying thereabove.

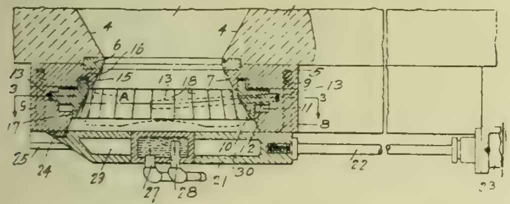
1,572,580.—**Method and Apparatus for Casting Plate Glass.** Frank E. Troutman and Charles H. Christie, Butler, Pa. Filed Dec. 28, 1921. Serial No. 525,327. 27 Claims. (Cl. 49—3.)



1. The method of casting molten glass that com-

prises establishing a body of molten glass above a discharge outlet, and then chilling the glass at the outlet to a predetermined thickness to cause the glass to issue slowly initially from the said outlet.

1,572,581.—**Casting Plate Glass.** Frank E. Troutman and Charles H. Christie, Butler, Pa. Filed Apr. 14, 1924. Serial No. 706,393. 26 Claims. (Cl. 49—55.)



1. The method of controlling the discharge of glass from an outlet, that comprises applying a chilling instrument to said outlet, thereby causing the glass within said outlet to harden, withdrawing said instrument from said outlet, and loosening the hardened glass in said outlet by downwardly moving a member adjacent to said glass within said outlet.

9. Apparatus for casting plate glass comprising a glass receptacle having a downwardly opening outlet, an annular structure beneath said outlet having a downwardly movable inner portion, and a shear member adapted to be moved into and out of position beneath the opening defined by said annular structure.

1,572,625.—**Glass.** William Chittenden Taylor, Corning, N.Y., assignor to Corning Glass Works, Corning, N.Y., a Corportion of New York. Filed Jan. 7, 1921. Serial No. 435,739. 10 Claims. (Cl., 106—36.1.)

1. The hereinbefore described process of modifying the colors due to metallic salts in borate glasses, which comprises adding a halogen.

1,572,730.—**Batch for Making Ceramic Material and to a Ceramic Material made therefrom.** Fred. M. Locke and Fred J. Locke, Victor, N.Y. Filed Oct. 17, 1924. Serial No. 744,287. 10 Claims. (Cl. 106—12.)

1. A raw batch for refractory bodies containing a relatively small amount of a compound of manganese and a relatively large amount of clay.

1,572,731.—**Container Pack.** Curtis L. Lynch, Cherryfield, Me. Filed Oct. 22, 1923. Serial No. 669,945. 3 Claims. (Cl. 215—56.)

1. A preserving container comprising an enclosed vessel having one wall recessed and vented, and a nipple within said recess and below the surface of said wall, and enclosing said vent and adapted to receive an exhaust connection.

GRANTED FEBRUARY 16, 1926.

1,572,975.—**Method of Heating Metal, Glass, or other Material to Render the same Workable.** James W. Van Meter, San Rafael, Calif. Filed June 5, 1922. Serial No. 566,204. 3 Claims. (Cl. 148—17.)

1. The herein described method of heating metal, glass and other materials to render the same workable, consisting in exposing such material to the action of heat generated in a non-oxidizing atmosphere by the chemical reation of a reaction causing agent on a body of initially inert material.

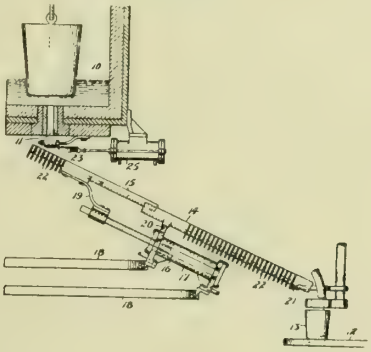
1,573,033.—**Method and Apparatus for Annealing and Cooling Sheet Glass.** Frederic L. Bishop, Pittsburgh, Pa., assignor to Window Glass Machine Company, Pittsburgh, Pa., a Corporation of New Jersey. Filed Sept. 4, 1924. Serial No. 735,789. 13 Claims. (Cl. 49—47.)

1. In the method of annealing and cooling sheet glass, the steps consisting in passing sheet glass through a leer, passing gaseous fluid through the leer in streams above and below the glass, and adjusting the relative cooling effect of the streams to maintain a predetermined relative temperature condition between a plurality of points in the leer, substantially as described.

1,573,072.—**Refractory Cement and Concrete.** Paul Jean Frederic Kestner, Boulogne-sur-Seine, France. Filed Mar. 12, 1925. Serial No. 15,139. 1 Claim. (Cl. 106—9.)

A composition of matter constituting a refractory cement, consisting of a mixture of 1 to 10 parts of bauxite which has been calcined at a temperature above the point of transformation of alumina, and 2 parts of a calcium aluminate cement containing at least 30 per cent. of alumina, the said calcined bauxite and calcium aluminate cement being mixed in the form of powder.

1,573,273.—**Glass-Flowing Device.** Claude W. Pleukharp, San Francisco, Calif., assignor to Illinois-Pacific Glass Co., San Francisco, Calif., a Corporation of California. Filed Feb. 23, 1922. Serial No. 538,528. 6 Claims. (Cl. 49—5.)

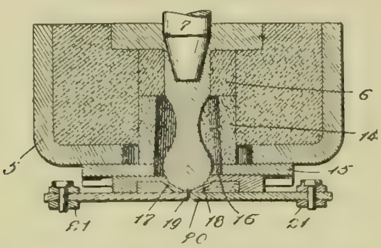


1. In a glass flowing machine a charging vessel, a mold carrying device, an inclined chute arranged between, said chute having a reciprocating upper portion and a stationary lower portion, and a compressed air cylinder and piston for actuating the reciprocating portion.

1,573,482.—**Fire Brick or Block.** Richard A. Daltan, Philo, Ohio. Filed May 16, 1925. Serial No. 30,878. 4 Claims. (Cl. 18—60.)

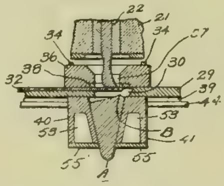
1. A fire brick or block including a body portion, said body portion comprising slag from a high temperature forced draft furnace which is free from ashes, a fire cement which sets hard at a high temperature, Portland cement which sets hard at atmospheric temperatures, and a facing composition comprising divided carborundum, a fire cement which sets hard at a high temperature, and Portland cement which sets hard at atmospheric temperature.

1,573,635.—**Method of Feeding Glass to Forming Machines.** Leo A. Drey, St. Louis, Mo., assignor by mesne assignments, to Ball Brothers Company, Muncie, Ind., a Corporation of Indiana. Original application filed Dec. 14, 1914. Serial No. 877,070, Patent No. 1,146,694, dated July 13, 1915. Divided and this application filed June 28, 1915. Serial No. 36,724. 27 Claims. (Cl. 49—77.)



1. The method of delivering glass from a furnace to a mold, which consists in flowing glass on a support which contacts with only a portion of the batch and subjecting the free unsupported remaining portion of the batch to heat.

1,573,636.—**Apparatus for feeding Glass into Moulds.** Leo. A. Drey, St. Louis, Mo., assignor, by mesne assignments, to Ball Brothers Company, Muncie, Ind., a Corporation of Indiana. Filed Oct. 18, 1920. Serial No. 417,765. 6 Claims. (Cl. 49—55.)



3. In an apparatus for gathering molten glass from a continuously flowing stream, comprising a supporting plate having a central opening therethrough, said opening being concentric with the stream of glass, a recess formed in the upper face of said plate, a knife slidably located in said recess, means for operating said knife periodically across said opening for closing the same and severing the oncoming stream of glass, a bottomless cup composed of separable members slidably secured to the underside of said supporting plate, and means for moving said separable members to and from each other when the opening in the supporting plate is closed.

1,573,742.—**Feeding Molten Glass.** Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Fairmont Company, Hartfod, Conn., a Corporation of New York. Filed Nov. 25, 1925. Serial No. 71,369. 37 Claims. (Cl. 49—55.)

16. Apparatus for separating molten glass into mold charges, including a container for the glass having an outlet, severing means operating periodically beneath the outlet, means for timing the suspension of successive gathers of glass beneath the outlet in timed relation to the operation of the severing means, and means for varying the time of beginning of the suspension period relative to the time of severing.

GRANTED FEBRUARY 23, 1926.

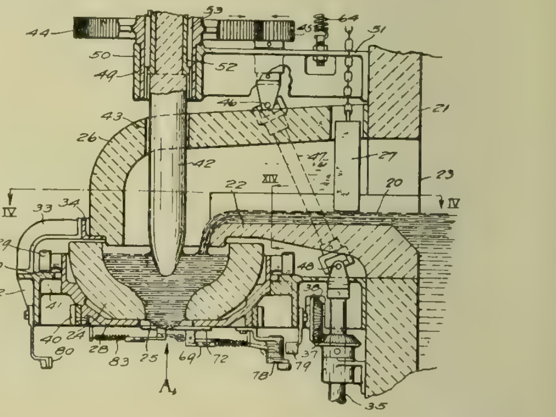
1,573,888.—**High-Temperature Cement.** Paul G. Willetts, Berlin, Conn, assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed Nov. 13, 1925. Serial No. 68,917. 8 Claims. (Cl. 106—9.)

1. A cement containing barium sulphate, silica and silicate of soda.

1,574,156.—**Process for Manufacturing Photographic Glass Pictures and the Like with Coloured Back-Ground.** Werner Kiesling, Berlin-Neukolln, Germany, assignor to N. V. Handelmaatschappij, "Mercator," Zandvoort, Netherlands. Filed Dec. 18, 1924. Serial No. 756,827. 3 Claims. (Cl. 41—21.)

1. A process for the photomechanical manufacturing of glass pictures and the like with coloured background, wherein the transparent plate or the like is coated with a thin layer of chromate glue soluble in the cold, the coated side of the plate being exposed under a reticle negative, the unaltered glue being then removed from those portions of the plate which were protected from light during the exposure under the reticle negative, the exposed portions being then coloured with a dye solution, and the entire coated side of the plate and especially those portions from which the light-sensitive layer has been removed being finally painted with another colouring substance for the production of the background.

1,574,709.—**Apparatus for Delivering Charges of Molten Glass.** Leonard D. Soubier, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Filed Dec. 20, 1920. Serial No. 431,847. 30 Claims. (Cl. 49—55.)

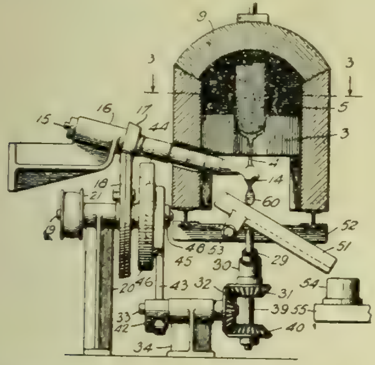


7. The combination with a receptacle to contain molten glass having an outlet opening in the bottom thereof, means to rotate the receptacle about the vertical center line of said opening as an axis, a regulator projecting downward into the glass in the receptacle over said outlet, means to reciprocate said regulator toward and from the outlet and thereby control the discharge of glass through the outlet, a cutter mounted to rotate with said receptacle beneath said outlet, and automatic means operating in synchronism with the movements of said regulator to periodically actuate the cutter and thereby sever charges of glass issuing from said outlet.

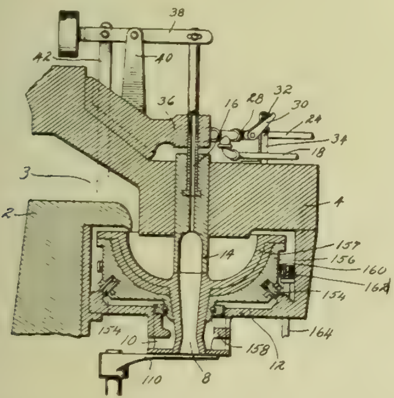
1,574,736.—**Feeder for Molten Glass.** Karl E. Peiler, Hartford, Conn., assignor, by mesne assignments, to Hartford-Empire Company, a Corporation of

Delaware. Filed Aug. 3, 1912. Serial No. 713,143. 13 Claims. (Cl. 49—55.)

3. A feeder for molten glass, comprising a rotatable gathering head, means for rotating said head, and means for flowing molten glass upon said head, while rotating, whereby a layer of glass is accumulated around the head.



1,574,739.—**Method and Apparatus for Delivering Molten Glass.** Enoch Theodore Ferngren, Toledo, Ohio, assignor to Hartford-Fairmont Company, a Corporation of New York. Original application filed Sept. 29, 1913. Serial No. 792,383. Renewed Feb. 10, 1919. Serial No. 276,175. Divided and this application filed Sept. 19, 1925. Serial No. 57,454. 15 Claims. (Cl. 49—55.)



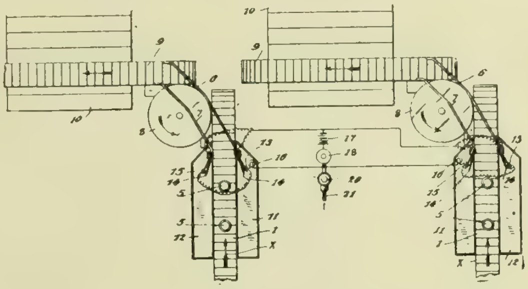
2. The combination of a receptacle to contain molten glass, said receptacle provided with an outlet orifice, and automatic means to cause an equalization of temperature within the receptacle comprising mechanism for rotating the receptacle about the axis of said orifice.

GRANTED MARCH 2, 1926.

1,574,903.—**Glass Machine.** Peter P. Kucera, Connellsville, Pa., assignor to Capstan Glass Company, Connellsville, Pa., a Corporation of Delaware. Filed Mar. 24, 1920. Serial No. 368,238. 6 Claims. (Cl. 49—38.)

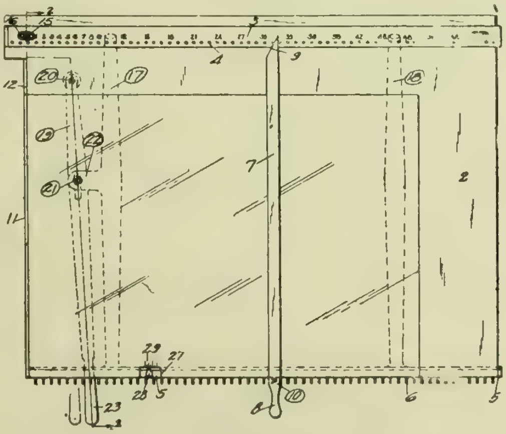
1. In an automatic glass machine, the combination of pressing devices, a plurality of interacting controllers for controlling the operation of said pressing devices, a timer for operating said controllers, an automatic relief device operative on one of said controllers for relieving the pressure on said devices when the pressure has reached a predetermined limit, a tank of predetermined capacity to receive the relieved pressure and to regulate the final pressure, and a regulating outlet valve on the tank.

1,574,914.—**Automatic Conveyor Signal.** William L. McNamara, Connellsville, Pa., assignor to Capstan Glass Company, Connellsville, Pa., a Corporation of Delaware. Filed Oct. 6, 1923. Serial No. 666,894. 6 Claims. (Cl. 198—40.)



4. In a device for conveying hot glass ware; a conveyer; a rotary transfer device for transferring ware from said conveyor; guide rails cooperating with said rotary transfer device, shelves adjacent the front end of said rails to support ware pushed from the conveyer; electrical contacts attached to the front ends of said guide rails, said contacts being normally open and being adapted to be closed by ware pushed from the conveyer; and signalling means connected to be set in operation by the closing of the contacts.

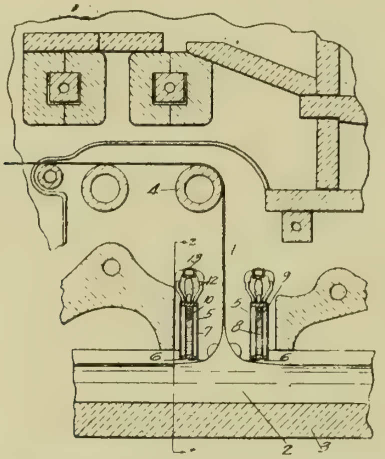
1,574,965.—**Glass-Cutter's Table.** Lawrence A. Grolemund, Charleston, W. Va., assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed Nov. 12, 1923. Serial No. 674,142. 6 Claims. (Cl. 33—180.)



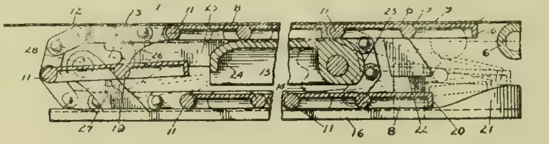
1. A glass cutter's table, comprising a plane sheet supporting member, a pair of parallel measuring bars movably mounted in the member adjacent opposite edges thereof, and means for simultaneously adjusting the bars.

1,574,984.—**Drawing Sheet Glass.** Thomas C. McKinley, Charlestown, W. Va., assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed Nov. 5, 1923. Serial No. 672,801. 6 Claims. (Cl. 49—17.)

1. A cooler for use in sheet glass drawing apparatus comprising a hollow casing having a plurality of compartments, means for passing air through the compartment closet to the sheet being drawn, and means for passing a cooling fluid through the remaining compartments.

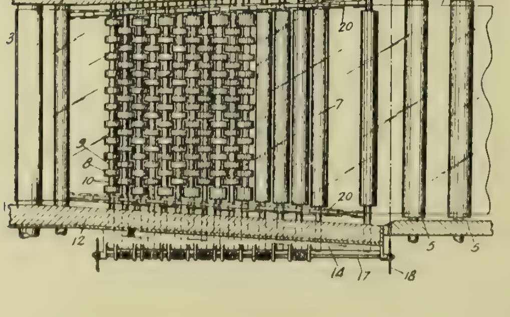


1,575,006.—**Drawing and Flattening Table for Sheet Glass.** Clifford A. Rowley, Toledo, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed Jan. 25, 1924. Serial No. 688,357. 5 Claims. (Cl. 49—17.)



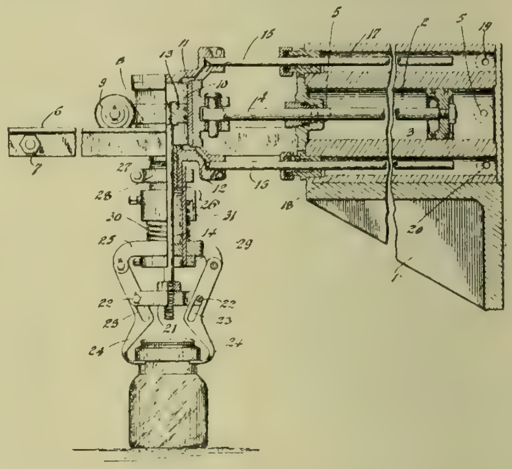
1. A drawing and flattening table for sheet glass, comprising an upper stationary table and a lower stationary table, the tables each having upper flat horizontal supporting surfaces, a series of flat sheet-supporting plates, and means for moving the plates successively along the upper table beneath and with the glass sheet, and then returning them along the lowe table, the sheet-supporting surfaces of the plates always remaining uppermost, and out of contact with the tables.

1,575,007.—**Drawing and Flattening Table for Sheet Glass.** Clifford A. Rowley, Toledo, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed Jan. 30, 1924. Serial No. 689,398. 10 Claims. (Cl. 49—17.)



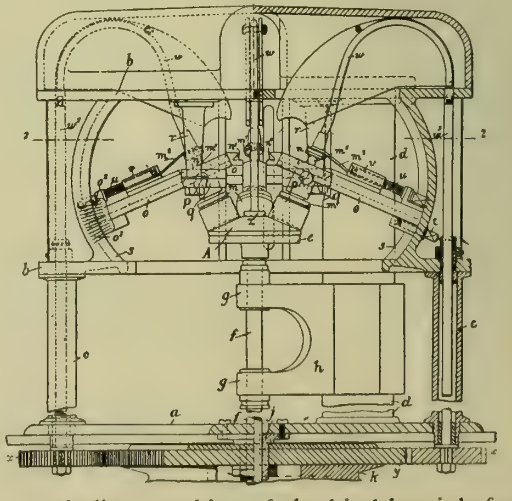
1. In a sheet glass drawing apparatus, a supporting and flattening table for the moving sheet, formed of a plurality of closely positioned parallel rollers, the upper sheet-supporting surfaces of the rollers all lying in the same plane, in combination with continuous means at the sides of the table for supporting and drawing longitudinally the edge portions of the sheet.

1,575,185.—**Automatic Transfer Device.** Thomas Stenhouse, Washington, Pa., assignor to Hazel-Atlas Glass Company, Wheeling, W. Va., a Corporation of West Virginia. Filed Sept. 17, 1923. Serial No. 663,222. 12 Claims. (Cl. 214—1.)



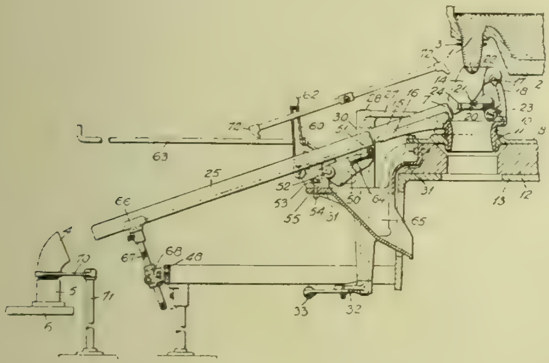
1. A transfer device for glass ware including a fluid pressure cylinder, a vertically reciprocable piston rod operated thereby, a cross-bar carried by the piston rod, a pair of pivotally mounted grippers operatively connected with the crossbar and having downwardly and inwardly inclined slots therein, means carried by the crossbar engaging said slots to open and close the grippers and to lift them bodily, and means for reciprocating the cylinder and piston bodily in a substantially horizontal plane.

1,575,311.—**Machine for Grinding Lenses.** Malcolm Bentzon, Neuilly-sur-Seine, France. Filed July 5, 1921. Serial No. 482,438. 1 Claim. (Cl. 51—131.)



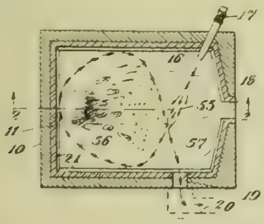
A lens grinding machine of the kind hereinbefore referred to, comprising a lens holder, a plurality of grinding discs designed to act upon one only of the two lens surfaces, means whereby each grinding disc can be presented to the lens at the angle required to grind or polish convex or concave surfaces thereon and a stop to contact with the centre of the lens to determine the grinding position therefor.

1,575,370.—**Glass Delivering Apparatus.** Edward H. Lorenz, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed Apr. 7, 1919. Serial No. 287,966. 35 Claims. (Cl. 49—55.)



12. A chute for delivering molten glass comprising a plurality of movable sections located in delivering continuity, a support common to said sections, means for moving said sections in unison upon said support and means for moving one of said sections vertically out of delivering continuity with another section, independently of its movement on said support.

1,575,514.—**Apparatus for Making Glass and Process Therefor.** Robert R. Shively, Washington, Pa., assignor to B. F. Drakenfeld & Co. Inc., New York, N.Y., a Corporation of New York. Filed Apr. 12, 1924. Serial No. 706,010. 7 Claims. (Cl. 49—54.)



1. In the art of making glass, placing a mass of the raw materials within a furnace chamber, said mass covering a minor portion of the chamber floor surface adjacent one end thereof, directing a heating medium into enveloping contact with said mass to subject the surface thereof to the uniformly distributed heat effect of said medium whereby the mass is fused with a progressive and uniform reduction in the bulk thereof, and directing the melt away from said mass as the latter is fused to an outlet at the opposite end of the furnace chamber.

SILLIMANITE

a neutral refractory material having a definite fusing temperature above 3270°F (1800°C).

The December issue of GLASS reported the following expert opinions expressed in papers or discussion at the Leeds Meeting of the SOCIETY OF GLASS TECHNOLOGY:—

Mr. H. H. Houldswoith (of the Fuel Department, Leeds University).

"*Experiments made on commercial sillimanite bricks showed that they exhibit very little permanent change in dimensions on heating, their refractoriness is high, and they offer great resistance to attack by soda-lime-silica glass.*"

Mr. F. G. Clark (of Messrs. Beatson, Clark & Co., Ltd., Sheffield).

"*I can testify to the particular resistance to attack of a mixture of about 66⅔ per cent. sillimanite, from experimental data obtained at my works.*"

Professor W. E. S. Turner (of the Department of Glass Technology, Sheffield University).

"*Glass manufacturers seemed to be more keenly interested in the resistance offered to corrosion by glass, by a refractory material, than its ability to withstand unusually high temperatures.*"

Mr. W. J. Rees (of the Refractories Department, Sheffield University).

"*Sillimanite mixtures containing not less than 60% sillimanite were already justifying themselves for purposes where a highly refractory, resistant material was necessary.*"

P.B. Sillimanite is now available in the raw state, crushed and graded, and in the form of Bricks, Blocks, Shapes, etc.

The P.B. SILLIMANITE
COMPANY, LIMITED,

Sole Agents: PAWLE AND BRELICK

791, SALISBURY HOUSE,
LONDON WALL, LONDON, E.C.2.

Telephone Number - London Wall 4825.

BRITISH PATENTS.

The following abstracts are taken from the Illustrated Officia Journal of Patents with the special permission of the Controller of H.M. Stationery Office.

Printed copies of the full specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C., price 1/- each.

245,785.—**Glass Manufacture.** I. G. Farbenindustrie Akt.-Ges., 31, Gutleutstrasse, Frankfort-on-Main, Germany.—(Assignees of Chemische Fabrik Griesheim-Elektron; 31, Gutleutstrasse, Frankfort-on-Main, Germany.) Jan. 8, 1926, No. 580. Convention date, Jan. 8, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)

Production of metal.—In the production of glasses containing potash, potassium bicarbonate is used as a batch material instead of the carbonate.

246,057.—**Glass Manufacture.** Tennant, W. J., 111, Hatton Garden, London.—(Empire Machine Co.: Farmers Bank Building, Pittsburg, U.S.A.) Aug. 21, 1925, No. 21015. (Class 56.)

FIG.3.

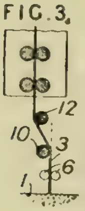


FIG.1

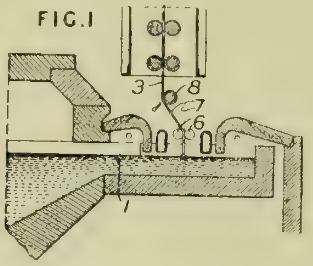
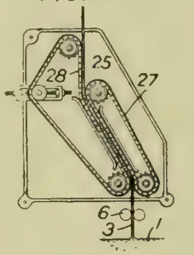


FIG.14



Drawing.—In order to flatten sheet glass made by a continuous drawing process, it is drawn vertically upwards from a mass of metal and is deflected through a small angle, the draw then being continued in a vertical plane. In the construction shown in Fig. 1, the sheet 3 is drawn vertically upwards from a mass of metal 1, and after passing between edge-gripping rolls 6, it is deflected through a small angle 7. It then passes over a roller 8 and continues upwards in a vertical plane into a lehr. The roller 8 flattens the sheet, but it may be provided with a pattern to produce figured glass. In a modification, a flattening-roller 10, Fig. 3, is arranged above the edge rolls 6, and the sheet is deflected over the roller to a second flattening-roller 12, whence it proceeds in a vertical plane. Other rollers may be used to press the sheet against the rollers 10, 12. The edge rolls may be dispensed with, and the deflecting or flattening-rollers may be reduced in diameter at their ends to permit the passage of the thickened edges of the sheet. In another modification, the flattening-roller may be replaced by stub rolls. Skew rolls co-operate with the stub rolls and exert a lateral stretching-action on the sheet. In a further modification, the edges of the sheet are gripped by endless chains 27, 28, Fig. 14, which cause the sheet to travel in the desired direction. The frames 25 by which each set of chains is carried are mounted on adjusting-screws so that they can be tilted to exert a lateral stretching-action on the sheet.

246,061.—**Bottles.** Narunsky, S., 3716, Springdale Avenue, Baltimore, U.S.A. Aug. 31, 1925, No. 21,761. (Class 125 (i).)

FIG.2.

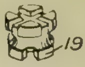


FIG.3.

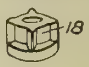


FIG.4.

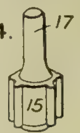
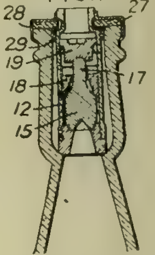


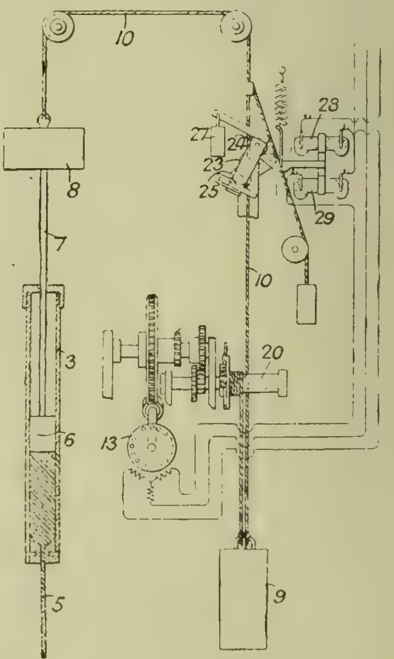
FIG.1



Bottles, non-refillable.—A valve device for a non-refillable bottle of the kind described in Specification 102,706 comprises a pouring-tube 12 secured in the neck of the bottle and containing a valve 15 having a weight 18 surrounding the valve-stem 17 and a guard 19 loosely seated on the top of the stem 17. The parts 15, 18, 19 are grooved as shown to prevent tampering with the valve, while allowing the liquid to flow out when the bottle is inverted. A cap 27 and jackets 28, 29 hold the tube 12 in place.

246,157.—**Fused Silica.** British Thomson-Houston Co., Ltd., Crown House, Aldwych, London.—(Assignees of Miller, L. B.; 188, Washington Street, Lynn, Massachusetts, U.S.A.) Jan. 15, 1926, No. 1,201. Convention date, Jan. 19, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)

FIG.1



A device for forming plastic material, particularly fused silica, into lengths comprises a piston for extruding the material through a die or opening, and means for applying pressure to the piston to overcome the resistance offered by the material, the pressure applied to the piston being varied automatically according to the resistance offered by the material. The silica is fused in a crucible 3 in an electric furnace, as described in Specification 189,926, and it is extruded through a die into a length 5. The pressure for extrusion is applied by means of a piston 6, an additional weight 8 being applied to the rod 7 of the piston if the weight of the piston is not sufficient. In order that the extruded length 5 may be of practically constant diameter, it is necessary that the rate of flow should be constant, and to ensure this, means are provided for varying the pressure on the piston. For this purpose, the weight 8 is connected by a cable 10 with a balance weight 9, and a motor 13 is provided to drive a winding-drum 20 which raises the weight 9 at a determined rate of speed. With this device, the weight 8 cannot descend at a greater rate than that at which the balance weight 9 is raised, and too great a rate of extrusion of the silica is prevented. If the silica becomes too viscous, the piston 6 is retarded, but the raising of the weight 9 allows the full force of the weight 8 to be applied to the piston. The cable 10 passes between pulleys 24, 25 carried by a pivoted frame 23, and when the cable is taut, the frame is held in the position shown. If the piston 6 is stopped by any means, the cable 10 slackens and the frame 23 is tilted by a weight 27. The movement of the frame opens a switch 28, 29, which stops the motor 13 and prevents excessive sagging of the cable 10.

246,451.—**Polishing Glass.** Zeiss, C., (Firm of), Carl-Zeiss-Strasse, Jena, Germany. Dec. 28, 1925, No. 32,667. Convention date, Jan. 22. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 60.)

A tool for polishing glass comprises a core coated on the working-surface with a polishing-layer comprising a mixture of polishing-powder and powdered resin or resin-like substance, which is heated to the fusing temperature of the resin or a temperature below fusing point. As applied to a flat or slightly curved tool, a core has applied thereto a mixture of the powder and resin-like substance, for example rouge and shellac in equal quantities, which is compressed by a plate and a clamp and then heated for about one hour at a temperature of about 100°. As applied to a concave tool of great curvature, the mixture is moistened with water, applied to the surface of the core, shaped by a convex tool and heated. In order to obtain a porous polishing-surface the heating is stopped before the grains of resin flow together completely.

246,480.—**Zirconium Oxide Refractories.** Deutsche Gasglühlicht-Auer-Ges., 11, Ehrenbergstrasse, Berlin. Jan. 21, 1926, No. 1,766. Convention date, Jan. 23, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 22.)

Zirconium oxide, obtained for instance by heating basic sulphates, is sintered at temperatures above 1,800° C. and is then worked up into refractory articles by known methods without particularly fine grinding. The articles are finally burnt at temperatures exceeding 2,000° C. The burning of the articles may be conducted in two stages, at 1,300° C. and above 2,000° C. respectively, or if pressure is used in forming the articles 1,600° C. is a sufficiently high burning temperature.

Latest British Patents.

Applications for Patents.

No. 5022.—February 22, 1926. J. S. Atkinson, Stein and Atkinson Ltd. Furnaces for combustion of fuel.

No. 5039.—February 22, 1926. (Bausch and Lomb Optical Co.). A. H. Stanley. Opthalmic mountings.

No. 5137.—February 23, 1926. A. H. Lymn. Production of gases from bituminous fuel.

No, 5183.—February 23, 1926. (United States, March, 10, 1925). Optical Development Corporation. Apparatus for grinding lenses.

No. 5236.—February 24, 1926. S. Black. Bottle washing and sterilizing plant.

No. 5241.—February 24, 1926. H. Burdin, N. Burdin, W. M. Oddie. Manufacture of carboys, etc.

No. 5275.—February 24, 1926. (Belgium February 28, 1925). H. Hennebutte, E. Goutal. Apparatus for carbonizing wood, etc.

No. 5387.—February 25, 1926. C. E. Foster. Optical pyrometers.

No. 5446.—February 26, 1926. J. B. Sanders. Non-Refillable bottles.

No. 5601.—February 27, 1926. G. M. Gibbins, Hayward, Tyler and Co., Ltd. Apparatus for syruping, filling and sealing bottles.

No. 5896.—March 2, 1926. (France, March 31, 1925). J. E. Renodier. Machines for making glass bottles, etc.

No. 5907.—March 2, 1926. W. W. Watts. Bottles, etc.

No. 5922.—March 2, 1926. F. S. Lowe, H Morris. Containers for beverages.

No. 6001.—March 3, 1926. M. W. Gorton. Horticultural glass frames.

No. 6093.—March 4, 1926. A. J. Denniss, F. Hainsworth. Single lens photographic objective.

No. 6132.—March 4, 1926. W. Duskow. Bottle stopper.

No. 6233.—March 5, 1926. E. C. R. Marks (Bautsch, Quilitz. and Co. Akt. Ges.). Seals for bottles, etc.

No. 6272.—March 6, 1926. P. Gribben. Bottle stoppers, etc.

No. 6535.—March 9, 1926. W. Donald. Manufacture of producer gas etc. from pulverised coal, etc.

No. 6636.—March 9, 1926. A. E. White, Pittsburgh Plate Glass Co. Manufacture of sheet glass.

No. 6700.—March 10, 1926. (Czecho-Slovakia, March 11, 1925). Dural Zrcadleni a Pokovovani skla Kommand. Spol. Epstein and Spol. Provision of protective layers on reflecting bodies.

No. 6724.—March 10, 1926. (Switzerland, March 13, 1925). C. Perdrisat. Apparatus for producing a combustible gas.

No. 6816.—March 11, 1926. (Belgium, May 15, 1925). Soc. Anon d'Ougree Marihaye. Gas valves.

No. 6864.—March 12, 1926. J. C. Davies. Bottles, etc.

No. 7043.—March 13, 1926. (United States, March 31, 1925). Hartford Empire Co. Annealing glassware.

No. 7050.—March 13, 1926. (United States, March 31, 1925). Hartford Empire Co. Annealing glassware.

No. 7085.—March 15, 1926. W. G. Beeston. Regenerative furnaces.

No. 7199.—March 15, 1926. (Libbey Manufacturing Co.). Glass article and manufacture of same.

No. 7215.—March 15, 1926. A. Kephart. Cutting and bottoming tubular glass, etc.

No. 7218.—March 15, 1926. P. H. Head, Safety Glass and Metal Products, Ltd. Manufacture of strengthened glass.

No. 7276.—March 16, 1926. T. Bishop, Saxton Chatterton and Co., Ltd. Closures for bottles, etc.

No. 7373.—March 17, 1926. W. H. Davies. Bottles.

No. 7379.—March 17, 1926. W. Donald. Manufacture of producer gas, carbon monoxide etc. from pulverised fuel.

No. 7686.—March 19, 1926. (Sweden, March 23, 1925). C. E. Cornelius. Electric glass etc. furnace.

No. 7784.—March 20, 1926. W. Donald. Manufacture of producer gas etc. from pulverised fuel.

Specifications Published.

231441.—March 31, 1924. H. Rouet. Machines for polishing purposes.

234101.—May 14, 1924. O. P. R. Lehmann. Optical projection apparatus.

238872.—August 20, 1924. Naamlooze Vennootschap International Octrooibureau. Apparatus for blowing hollow glass bodies.

239836.—September 12, 1924. Naamlooze Vennootschap International Octrooibureau. Apparatus for the periodic delivery of molten glass from a furnace.

240150.—September 16, 1924. A. J. Sterling. Closures for bottles and other containers.

240844.—October 1, 1924. Siemens-Schuckertwerke Ges. Electric gas-purifier plants.

242628.—November 4, 1924. Naamlooze Venootschap Philips' Gloeilampenfabrieken. Sealing-in machines for the manufacture of electric incandescent lamps and the like.

247148.—February 5, 1925. General Electric Co., Ltd. Electric incandescent lamps.

247655.—November 19, 1924. B. Watson and A. Thomson. Bottle washing machines.

247862.—September 23, 1925. F. W. Golby (Libbey Owens Sheet Glass Co.). Method of and apparatus for drawing sheet glass.

247896.—December 2, 1925. F. G. Ginzler. Closure for jars, glass bottles, tins and like containers.

248244.—July 8, 1925. T. Rombach. Attaching-means for cover glasses and the like.

248293.—October 23, 1925. (Addition to 235749) R. Mallinson & Co., Ltd. and H. Mallinson. Devices for removing capsule stoppers from bottles.

248445.—December 2, 1924. A Crowcroft. Means for supporting the bricks in a crown or roof for furnaces or the like.

248461.—December 4, 1924. J. Clegg. Dampers for furnaces and the like.

248518.—December 30, 1924. (Addition to 235958) Power-Gas Corporation, Ltd., and N. E. Rambush. Process for producing combustible gases and coke from bituminous fuel.

248555.—March 2, 1925. A. W. Puddington. Damper controlling mechanism for furnaces.

248569.—March 13, 1925. W. H. Clegg. Air compressor or blower.

248596.—May 14, 1925. R. W. Penn, W. A. Stephens and British Sure Seal Co., Ltd. Air-tight receptacles with removable covers.

248603.—May 26, 1925. (Convention date not granted). E. C. R. Marks (Kahlbaum Chemische Fabrik Ges. C. A. F.). Bottles.

248663.—May 22, 1925. Holstein Kappert Maschinenfabrik Phoni Ges. Bottle washing machines.

248678.—November 25, 1925. A. S. Alexander. Distinctive cork to be used in bottles for medical purposes, other than those containing medicine to be taken.

248841.—December 11, 1924. C. Cooper, D. M. Henshaw and W. C. Holmes and Co., Ltd. Manufacture of fuel gases.

248943.—April 8, 1925. E. C. R. Marks (Libbey Owens Sheet Glass Co.). Method and apparatus for forming sheet glass.

249046.—November 28, 1925. Holophane Ltd. and E. Stroud. Illuminating appliances.

248934.—March 30, 1925. R. Hadden. (Corning Glass Works). Electric insulators and means for making the same.

Specifications open to Public Inspection.

247918.—February 17, 1925. P. Liese. Composite glass and ferro-concrete coverings or structures for ceilings, floors, walls, and the like.

247926.—February 18, 1925. P. Muller and K. Rahlwes. Method of and means for capping bottles and the like.

247994.—February 23, 1925. A. Trippensee. Refractory materials for furnaces and ovens.

248369.—February 25, 1925. Pfalzische Chamotte Und Thornwerke (Schiffer and Kircher) Akt. Ges. Process for the manufacture of refractory bricks.

248403.—March 2, 1925. Corning Glass Works. Perforating glass.

248748.—March 5, 1925. R. Brunner. Method of and apparatus for producing artistic decorative effect by optical means.

249084.—March 10, 1925. Metal and Thermit Corporation. Lead in wires and method of making the same.

249094.—March 10, 1925. Optical Development Corporation. Apparatus for grinding lenses.

249152.—March 14, 1925. E. H. Kignell and E. P. Kignell. Regenerative heat exchanging apparatus.

Patents, Trade Marks, Inventions.—Advice, Handbook and Consultations free. King's Patent Agency Ltd., Director B. T. King, C.I.M.E., Regd. Patent Agent, G.B., U.S., and Canada, 146a, Queen Victoria Street, E.C.4, and 6, Quality Court (next Patent Office), London, W.C. 39 years' references. 'Phone: Cent. 682.

"Improvements in Glass Blowing Machines." The owners of British Patent No. 160366 are desirous of entering into negotiations with one or more firms in Great Britain for the purpose of exploiting the above invention, either by sale of the patent rights or by the grant of a licence or licences to manufacture on royalty. Enquiries should be addressed to Messrs. Abel and Imray, 30, Southampton Buildings, London, W.C.2.

◆◆

Patents and Designs Acts, 1907 and 1919. The proprietors of British Patents Nos. 139188, 139189, and 139190 are prepared to sell the patents or to licence British manufacturers to work thereunder. They relate to machines for cutting sheet glass. The glass is supported on a table or conveyor beneath a carriage carrying the cutting tools. Address: B. W. & T., 112, Hatton Garden, London, E.C.1.

◆◆

The owners of British Patents No. 193080 for Improvements in Machines for Blowing Glass, and No. 193365 for Improvements in transfer mechanism for Glass Blowing Machines, are desirous of entering into negotiations with one or more firms in Great Britain for the purpose of exploiting the above inventions, either by the sale of the patent rights or by the grant of a licence or licences to manufacture on royalty. Enquiries should be addressed to Messrs. Abel and Imray, 30, Southampton Buildings, London, W.C.2.

WANTED.

Advertiser is desirous of purchasing several Lynch machines type L.A. Must be good condition. Reply giving machine numbers, date of installation and where they may be inspected, to Box No. 304, Glass Publications Ltd., Talbot House, Arundel Street, Strand, London, W.C.2.

Prevailing Prices.

Arsenic (Continental or Japanese)	£15	15	0	ton
Arsenic (Refined white powdered)	£15	10	0	ton
Cobalt (Black Oxide)	*£0	8	0	lb.
Cobalt (Grey Oxide)	*£0	8	10	lb.
Cryolite (Synthetic) 99/100%	†£37	0	0	ton
Manganese Peroxide 85/87%	*£19	10	0	ton
Potash (Hydrated Carbonate) 83/85%	†£22	10	0	ton
Potassium Nitrate	*£24	0	0	ton
Red Lead, Finest English Manufacturing Glass Makers' quality	*£2	5	0	cwt.
Selenium (Black powdered) 99/100%	*£0	8	0	lb.
Soda Ash (Heavy)	£6	5	0	ton
Soda Ash (Light)	£5	17	6	ton
Sodium Nitrate (Refined Chilean) 96%	£13	7	6	ton
Sodium Nitrate (Synthetic) 96%	†£13	10	0	ton
Sodium Selenite	*£0	5	6	lb.
Sodium Silico Fluoride	*£17	0	0	ton

The above prices are for usual commercial quantities.

* d/d. Works.

† c.i.f. U.K. port.

GLASS

THE RECOGNIZED ORGAN OF THE GLASS INDUSTRY
Published on the Tenth of Each Month.

Single Copies - - - - One Shilling
Annual Subscription - - 10/6 post free

GLASS PUBLICATIONS Ltd.
TECHNICAL PUBLISHERS,
Talbot House,
Arundel Street,
Telephone: CENTRAL 5985. **Strand, London, W.C.2.**

CONTENTS.

PAGE
Editorial Notes 219
Practical Notes on the Thermal Endurance of Glass.—By H. V. E. Renn 220
Refractories for the Glass Industry.—By W. J. Rees, B.Sc.Tech., F.I.C. (Lecturer in Refractories, University of Sheffield) 224
Relative Value of Carbon Monoxide and Hydrogen as Constituents of Producer Gas.—By William E. Rice 227
The Society of Glass Technology 233
Trade Notes 237
The Use of Compressed Air.—By Robert Wilson 239
Books and Catalogues 243
The Optical Convention 244
Building Trades Exhibition 244
National Physical Laboratory 245
Budget and " Safeguarding " of Glass Industry.—By Our City Correspondent 246
March Trade Returns 251
United States Patents 252
British Patents 257
Latest British Patents 259

Editorial Notes.

GENERAL STRIKE.

Owing to the conditions arising out of the present general strike we greatly regret the delay in the publication and distribution of this issue and consequently would ask for the indulgence of our readers.

Glass Publications Ltd.

By the decision to call a general strike at midnight on May 3rd, the General Council of the Trades Union Congress immediately transformed what was an ordinary, though none the less very serious, industrial dispute into the closest approach to civil war that this country has known for centuries.

This decision was taken without any reference whatsoever to the rank and file of the Unions concerned and although large numbers of them obeyed the instructions to cease work there are already many indications that their action was dictated by fear rather than by sympathy with the T.U.C. This view is confirmed by the fact that since the Government issued its statement that " men staying in work or returning to work would be given protection after the present crisis is over," many men have returned to work.

Furthermore, many trade unionists who have left their employment in one district are volunteering for other work elsewhere.

All thinking men are agreed that trade unions have done a tremendous amount of good work in improving the working conditions in many industries and that, if devoted to the purposes for which they were instituted, are of real use to both employers and men.

The present situation, however, has arisen through the gross misuse of trades unions' power by a few men who have risen from obscurity by their ability to hoodwink their followers as to their main objective. They are influenced solely by a personal greed for power, combined with envy of the manner in which equally unscrupulous and obscure men have become the dictators of Russia. Quite a number of the General Council have studied these methods at first hand and their manifestos, etc., issued since the strike commenced, bear the mark of this alien influence.

The original cause of the dispute has now been forgotten in the greater issues at stake, i.e., as to whether Britain is to be ruled by its constitutional Government or whether it is to be misruled by the disciples of those who have made such a disaster of Russia.

There is really not the slightest reason to doubt the result for one moment, as the country as a whole is solid in its backing of Mr. Baldwin and his policy of fighting the usurpers.

Inconveniences and annoyances will be experienced by all and the financial cost will be heavy, but it will be worth while if only we can abolish the hypocrisy, underhand work and intrigues, etc., which are masquerading under the guise of Trade Unionism at the present time, and this will be achieved if only the Nation follows the Prime Minister's advice in his message.

" Constitutional Government is being attacked. Let all good citizens whose livelihood and labour have thus been put in peril bear with fortitude and patience the hardships with which they have been so suddenly confronted. Stand behind the Government, who are doing their part, confident that you will co-operate in the measures they have undertaken to preserve the liberties and privileges of the people of these islands. The laws of England are the people's birthright. The laws are in your keeping. You have made Parliament their guardian. The general strike is a challenge to Parliament and is the road to anarchy and ruin."

[GLASS *will deal with all matters pertaining to the industry in an impartial manner, consequently the Editor does not necessarily associate himself with the opinions expressed by his contributors.*]

Practical Notes on the Thermal Endurance of Glass.

By H. V. E. RENN.

The fracture of a glass vessel takes place when the tension at any point somewhat exceeds the elastic limit. As the tension is primarily proportional to the temperature gradient it is evident that the smaller the latter, i.e., the greater the rate at which the heat is conducted, the less the probability of fracture. The tension is also proportional to the coefficient of expansion, for the greater the rate of expansion the more intense the stresses set up.

Winkelmann and Schott adopted the formula:

$$F = \frac{P}{\alpha E} \cdot \frac{K}{SC},$$

as the measure of power to withstand inequality of temperature, and called it the thermal coefficient of endurance. It will be seen from the formula that the properties directly affecting the thermal endurance are the tensile strength (P) elasticity (E) and expansion (*a*) while the remaining properties, the conductivity (K) density (*s*) and specific heat (*c*) produce an effect proportionate either directly or inversely to their square roots.

In previous articles the thermal endurance of a glass has been considered with relation to expansion and conductivity. It has been pointed out that these properties should be known with precision, and that the conditions aimed at in practice should be the lowest possible coefficient of expansion and the highest conductivity coefficient. In selecting a glass for any particular purpose, however, it is invariably found necessary to arrange a compromise between the several factors, depending upon conditions of manufacture as well as of use. When deciding upon a bottle glass, for example, it may be necessary to sacrifice the thermal properties in order to obtain greater mechanical strength.

Elasticity.

The coefficient of elasticity (Young's modulus) is a factor that should always be taken into account, since it has a direct influence upon the thermal endurance. When a force is applied to a mass of glass, the various portions of the glass are displaced relatively to one another, and the glass is said to be under strain. The internal force that is set up to resist strain is called stress, and bodies which develop this restoring force are said to be elastic. Young's modulus of elasticity is defined as the ratio of the stress to the strain, i.e., $\text{elasticity} = \frac{\text{stress}}{\text{strain}}$, and it is evident from this that the amount of stress which can be developed in a glass without causing fracture is directly related to the elasticity.

Experimental Determination of Elasticity Coefficient.

Winkelmann and Schott were the earliest to investigate the elasticity of glass upon systematic lines. They determined the value of Young's modulus for 19 different glasses, employing highly accurate methods of measurement. A rod of rectangular section was supported on two fixed knife-edges. Weights placed in the middle of the rod caused the two ends to turn in opposite directions through the same angle ϕ. This angle was observed and the value of Young's modulus calculated from the formula:

$$E = \frac{3}{4} \frac{l^2}{a^3 b} \frac{P}{\tan \phi},$$

l denoting the distance between the knife-edges, *a* and *b* the depth and breadth of section respectively, and P the load. In order to determine the angle ϕ, a modification of a method indicated by König* was used. A mirror was placed at each end of the rod so that a ray of light from a point A (Figure 1) of a distant scale is reflected from C to B, and thence into the observing telescope D.

The displacement v of the point A in the scale was observed when the rod was bent by application of a load. The angle marked β was about 86°, and the modified form of the equation used:

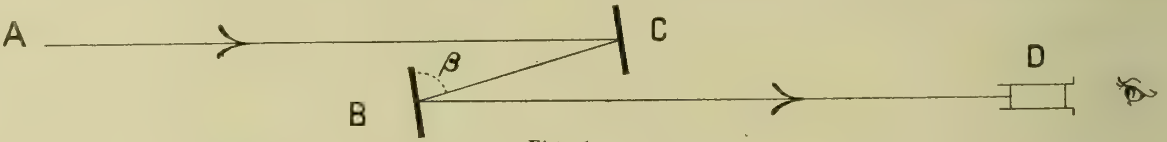


Fig. 1.

$$E = 3\left(AC + \frac{BC}{2} \right) \frac{l^2}{a^3 b} \frac{P}{v} \sin \beta.$$

Winkelmann later investigated a similar series of glasses, and obtained results that compared favourably with those previously observed. The following table shows some of the results obtained, the values given being the mean of the two determinations. The numbers given to the glasses are those found in Winkelmann and Schott's list of 72 glasses.

Some investigations have been recently made by Clarke and Turner† upon the influence of lime on the value of Young's modulus of elasticity for the soda-lime glasses. They adopted a method similar in principle to that of Winkelmann and Schott. A glass rod was supported at its two ends upon parallel horizontal knife-edges, a pan being suspended from the centre by thin wire. Weights placed in the pan caused depressions which were observed for varying loads up to one kilogram. The mean depression for a load of 100 grams was determined , and Young's modulus calculated from the formula :

---

*Winkelmann Handb. d. Phys. 1 263.

†J. Soc. Glass Tech. III. 260.

$$E = \frac{100 l^3}{12 \pi r^4 d},$$

where *r* is the radius of the rod, *l* the distance between the knife-edges and *d* the depression.

TABLE I.

Glass No.	Composition per cent.										Values of Young's modulus, kg/mm².
	SiO_2	B_2O_3	Al_2O_3	ZnO	Na_2O	PbO	K_2O	BaO	MgO	CaO	
19 = 5	71.0	14.0	5.0	—	10.0	—	—	—	—	—	7429
25	70.6	—	—	12.0	17.0	—	—	—	—	—	6632
26	41.0	—	—	—	—	51.7	7.0	—	—	—	5464
28	64.6	2.7	—	2.0	5.0	—	15.0	10.2	—	—	6613
29 = 8	67.9	—	1.0	5.8	16.8	8.1	—	—	—	—	6576
34	70.2	12.0	4.5	—	10.3	—	—	—	3.0	—	7090
35 = 7	73.8	—	3.5	5.0	10.5	—	—	—	—	7.0	7195
38 = 6	67.3	2.0	2.5	7.0	14.0	—	—	—	—	7.0	7402

The results obtained by Clarke and Turner are reproduced below in Table II, together with the percentage composition of the glasses tested.

TABLE II.

Glass No.	Composition per cent.						Values of Young's Modulus, kg/mm².
	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	
1	74.25	0.42	0.16	trace	—	25.37	5784
2	73.90	0.21	0.14	1.57	—	23.80	5930
3	74.05	0.22	0.14	2.63	—	23.00	6175
4	74.02	0.29	0.15	3.79	—	23.15	6332
5	73.77	0.34	0.18	4.54	0.16	20.78	6426
6	73.21	0.55	0.62	6.22	0.22	19.38	6700
7	73.97	0.76	0.18	7.56	0.23	17.30	6804
8	74.82	0.38	0.09	8.15	0.26	16.30	6965
9	74.92	0.38	0.17	9.26	0.31	14.88	7034
10	74.59	0.48	0.17	10.40	0.29	14.22	7249
11	74.93	0.38	0.16	11.63	0.31	13.02	6912
12*	75.30	—	—	13.00	—	11.70	7642
16	66.67	1.43	0.32	18.06	0.85	12.72	8343

***Calculated from the approximate chemical composition $6SiO_2$, $1.1CaO$, $0.9Na_2O$.**

It is seen from the above table that when lime replaces soda there is a continuous increase in the elasticity from 5,784 kg/mm² with no lime, to 8,343 kg/mm² with 18 per cent. lime. It was pointed out by the investigators that the greater elasticity imparted to glass by lime is an explanation of what is noted in actual practice, that a glass of high lime content is stronger than a glass high in soda and of low lime content.

The results are given overleaf in graphical form, with elasticity plotted against the percentage of lime contained in the glass, in order that the relation between composition and elasticity can be examined more closely.

Increase of Young's Modulus of Elasticity in substituting Lime for Soda.

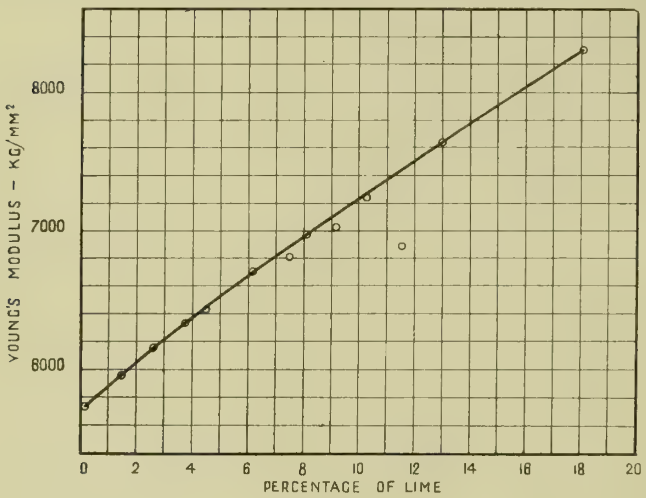


Fig. 2.

It will be seen that the resulting curve is practically a straight line, so that the relation between composition and elasticity is a linear one in a series of similar glasses. The one glass which appears to show any serious divergence is No. 11. Clarke and Turner, commenting upon this, say :—" It was expected that this deviation was accidental, and for this purpose determinations were repeated, but the earlier determinations were confirmed as the result. There is at present no explanation forthcoming why this sudden break should occur in the continuous increase of elasticity with the proportion of lime, and for the present no stress is laid on it. If there is a real break, then it must be due to some special circumstance, since glasses with still higher proportions of lime exhibit a still greater elasticity."

It must be pointed out, however, that there are many factors that tend to affect the determination of the elasticity constant. The rod used in the experiments should be made from well annealed and homogeneous glass, and should be free from bubbles. In addition it should be perfectly cylindrical if precise results are required, and should exhibit true parallelism throughout its length. In the tests carried out by Clarke and Turner, rods 20 cm. in length were used, and the diameter did not vary more than 1 per cent. This made possible an error of approximately 4 per cent. in the final value. Precise measurements of the extent of the bending were not made, while slight corrections rendered necessary by the formula used were omitted.

The rods in Winkelmann and Schott's investigations, and later in those of Winkelmann, the mean depth of the cross section was 3 mm. and the mean breadth, 15 mm. That such elaborate precaution should be taken to eliminate small errors in the observations does not appear warrantable since the glass used in some of the rods was defective.

The determination of Young's modulus (Adiabatic) for various glasses was carried out by Bell* who favoured the acoustical method. He claimed that the method was the simplest for the determination, but it had been little used, doubtless because of the well-known difficulty in obtaining glass rods of the required length sufficiently uniform for the purpose. It was originally intended to determine the tones given by longitudinal vibration of a number of rods or tubes of the glasses by observation of the beats produced when a steel rod of nearly equal and known pitch was caused to vibrate simultaneously. The glass rods were then cut into ten sections, and their weights and measurements determined. From these data it was intended to construct a diagram for each rod representing the vibration in the cross section throughout its entire length. It was expected that a few of the more nearly uniform of the rods might be selected, from the tones of which it would be possible to calculate Young's modulus. Inspection of the diagrams showed, however, that the parallelism was not nearly perfect enough to carry out this object. A correction, in the form of an " addition in length " was therefore calculated which made it possible to compute the velocity of sound through the rod from the rate of vibration as if its cross-section were constant. Mathematical proof that the correction, somewhat empirically applied, was strictly in accordance with theory, was given in an appendix by Chree. The following results were obtained :—

Table III.

Glass.		Density.	E at O°.		
Soft German a	...	2.508	6.95 × 10″	dynes/sq.	cm.
,, b	...	2.507	6.91 × 10″	,,	,,
,, c	...	2.488	6.91 × 10″	,,	,,
Bohemian ...	...	2.394	6.38 × 10″	,,	,,
Gauge-tube	...	2.525	7.36 × 10″	,,	,,
Soft Jena ...	...	2.499	7.16 × 10″	,,	,,
English Flint a	...	3.164	5.30 × 10″	,,	,,
,, b	...	3.136	5.39 × 10″	,,	,,

Variation of Young's Modulus with Temperature.

Winkelmann examined 24 glasses for variation of elasticity with a rise of temperature, the observations extending up to the point of softening. The apparatus used was as before, but with slight modification, and for these experiments was enclosed in a suitable metal case. It was found necessary to allow for several errors due to the effect of heat on the apparatus and for thermo-elastic after-effects. It was found that when a glass is first examined for elasticity at, say, 20°, and is then raised to a temperature approaching its softening point, upon a second examination at 20° it exhibits greater resistance to bending than before heating. If the glass is only once treated in this manner the larger elasticity observed at 20° gradually assumes its former value. The elasticity becomes constant, however, upon several successive heatings and intervals of cooling. Some of the glasses used in Winkelmann's experiments show the presence of stress, and it is possible that this may have been partly responsible for the phenomenon. It is well known that one of the effects of the release of stress or the partial release of stress is an elastico-viscous movement that often requires a considerable period to reach its limit, but so far as the present writer is aware no experimental work has been carried out upon the elastic properties of glass during the period of movement. It is not improbable that the elasticity would be found to decrease during an elastico-viscous movement following the release or partial release of stress.

---

*Phil. Mag., 9; 415.

Some of the results obtained by Winkelmann are given in Table IV, the elasticity constants being those observed after successive heatings and periods of cooling.

Table IV.

Glass.	$1 - (E_t/E_{20})\ 100$				
	100°	200°	300°	400°	500°
19 = 5	0.01	0.11	0.38	0.85	1.95
25	1.32	3.38	5.66	8.07	—
26	0.00	0.02	1.18	- -	—
28	3.01	6.77	10.53	14.29	—
29 = 8	0.00	0.14	1.44	7.05	—
34	0.10	0.23	0.36	0.49	0.62
35 = 7	0.69	1.85	3.16	4.57	6.06
38 = 6	0.50	1.91	4.17	6.82	—

No result is given for glass No. 26 at 400°, as the glass was on the point of softening at this temperature. The same remark applies to the five glasses for which no result is given at 500°.

Winkelmann suggests that comparatively high alkali content favours the change of elasticity with temperature, but that the presence of boric oxide along with the alkalies tends to have the reverse effect. Glasses Nos. 19=5 and 34 are notable examples of this. The elasticity of lead-containing glasses does not appear to be much influenced by temperature changes. Two lead glasses, Nos. 26 and 29=8 are included in Table IV.

Bell, who examined[*] a flint glass made by Powell, possessing the same general character as glass No. 26, states that Young's modulus was sensibly constant between the temperature limits of the experiment. In a special experiment with the soft German glass *a* (Table III) a diminution in the elasticity was observed of 1.12 per cent. from 5° to 100°. Mayer[†] states that Young's modulus for St. Gobain glass diminishes by 1.16 per cent. for a rise in temperature from 0° to 100°.

Calculation of Elasticity Coefficient.

Winkelmann and Schott attempted to express the elasticity of a glass as a linear function of the percentages of its constituent oxides. This does not appear unreasonable when it is considered that the increase in the elasticity with increased proportions of lime, as indicated by Fig. 2, follows a simple law, the relation between composition and elasticity being represented by what is almost a straight line.

To express the elasticity in terms of the percentages of oxides present, the following formula was used :

$$E = a_1x_1 + a_2x_2 + a_3x_3 + \quad \dots,$$

a_1, a_2, a_3, ... being the percentages of the constituent oxides and x_1, x_2, x_3, ... the unit contributions of those oxides to the elasticity, that is to say, x is that fraction of the total elasticity which is contributed by each 1 per cent. of the constituent oxide.

The values of x at first assigned to the oxides were found to be unsatisfactory when an attempt was made to calculate the elasticity of a second series of glasses examined by Winkelmann. Lime and soda, for example, were assumed to have the same effect upon the elasticity and were given identical values. The whole set of values was afterwards modified by Winkelmann, who divided the glasses examined into three groups, A, B and C, and assigned to each group a different set of factors. Group A includes the pure silicate glasses containing neither boric oxide nor phosphoric acid, and which are free from baryta and magnesia. Group B comprises the borosilicates free from lead and phosphoric acid, while group C includes all those glasses not identified with either group A or B.

The fractions of the total elasticity contributed by each 1 per cent. of the constituent oxides are given in Table V below.

Table V.

Oxide.	A.	B.	C.
SiO_2	70	70	70
B_2O_3	—	60	25
ZnO	52	100	—
PbO	46	—	55
MgO	—	40	30
Al_2O_3	180	150	130
BaO	—	70	30
Na_2O	61	100	70
K_2O	40	70	30
CaO	70	70	—
P_2O_5	—	—	70

The elasticity coefficient for the eight glasses comprising Table I have been calculated by means of these factors, and are given in Table VI on page 225. The results found by experiment are also given for the sake of avoiding cross-references.

Glass No. 28 shows a large divergence, but out of 28 glasses to which the factors were applied only two exceeded an error of 5 per cent., the average error being approximately 2 per cent.

Clarke and Turner calculated the elasticity coefficients for their own series of glasses by means of Winkelmann and Schott's first set of factors, but neither these nor the revised set of values (Table V) gave results that were in any way comparable with experimental observations. For this reason the investigators condemned Winkelmann and Schott's factors for soda and lime, and made the attempt to assign new

[*Continued on page* 225.

---

[*] Loc. cit.

[†] Phil. Mag. (5)xli. p. 168.

Refractories for the Glass Industry.

By W. J. REES, B.Sc.Tech., F.I.C. (Lecturer in Refractories, University of Sheffield.)

Introduction.

It is scarcely necessary to emphasize the essential importance of refractory materials in present day civilisation as their utilisation is at the basis of practically all industrial operations. During the European War an important limiting factor in the production of munitions was the rate of production and application of refractory materials for the building and maintenance of furnaces for the glass, ceramic and metallurgical industries. Much less than a generation ago it could be justly said that the technical study of the production and use of refractories both in Great Britain and America was on a much lower plane than in Germany, but during the last ten years the leeway has been made up to the advantage of both manufacturer and user. Both manufacturers and users are keenly alive to the importance of research and their attitude offers every encouragement to those whose duty it is to carry on the work. In Great Britain, the natural resources of raw materials for the manufacture of fireclay and silica refractories are of great extent, and these products are at the present time at least equal to those of other countries. The raw materials for special refractories, such as sillimanite, which are not found in this country occur in considerable quantities in the British Empire. A contributor to the discussion of a paper read by the author a short time ago suggested that the best silica fire-brick of to-day is no better than that of five and twenty years ago; even if this were so, there is no doubt whatever that the average quality of silica firebricks is decidedly higher now than formerly, and the same may be said of all types of commercial refractories. Despite the progress which has been made and the new types of refractories which have been introduced, the need for the production of refractories of greater durability is an urgent one. Progress in the glass industry is necessitating the provision of refractories which will have a high resistance to the severe conditions set up by higher working temperatures, new types of glass and greater pull on the furnaces.

A difficulty which is being rapidly eliminated is the lack of precise knowledge of conditions existing in the various parts of glass-melting furnaces which has led, at times, to the use of materials the failure of which was inevitable. The proper selection and efficient use of refractories which will have a high durability factor, and so assist in maintaining a continuous output, are important factors in the cost of glass production. In particular cases, the success or failure of an operation may be entirely dependent on the suitability of the refractories used for the construction or lining of the furnace. The life of a furnace or furnace lining should, therefore, not be measured in days, weeks, or months; the factor to ascertain, and the only sound basis on which to make comparisons is the cost of refractories per ton (or other unit) of saleable glass. Inefficient, badly selected or badly used refractories, such as pots or tank blocks, may so seriously affect the quality of the glass as materially to reduce the quantity of saleable product. In such cases, the factor due to deterioration of product through "failure" of refractories is of vital importance. It is, perhaps, desirable to point out that the term "failure" applied to refractories may have a wide range of meaning. Under severe conditions, the expected life may be only a few weeks, whilst under other less severe conditions it may be years. "Failure" may, therefore, be loosely defined in terms of a life much shorter than the average or in terms of a much higher cost in refractories per unit of satisfactory product. An analysis of failures which have come under the author's notice enables the placing of them into four classes:—

(a) Unsatisfactory quality, including lack of uniformity of quality.

(b) Faulty selection owing to the absence of knowledge of the conditions to be met.

(c) Faulty treatment of the material in service, due either to accident, carelessness or ignorance.

(d) Failure to allow a margin so that abnormal conditions of short duration may be withstood. (Or, in other words, the absence of a "factor of safety.")

Failures of the second and third classes are quite as numerous as those of the first class. Typical examples of the second class (b) are the use of silica bricks in situations which are exposed to abrupt alternations of temperature with only a moderately high maximum; and the use of course open-textured bricks exposed to the abrasive action of hot, dust-laden gases. Typical examples of the third class (c) are too rapid heating of furnaces in which silica bricks are used for the crown or walls; and failure to relieve stresses due to thermal expansion by slackening tie-bolts. Examples of the fourth class (d) are found in abnormal regenerator temperatures due to a breakdown in the reversing mechanism of regenerative furnaces; and the temporary overloading of a steam-raising plant. It should be possible to completely eliminate failures of the first two classes and those of the third class can be reduced to a marked extent by the education of charge-hands or the payment of a bonus to furnace operators on the tonnage-life of furnaces and pots.

The refractory materials used in the manufacture of glass can be divided into two broad classes, viz, those which are in actual content with the molten glass and those which, whilst exposed to the action of dust or volatile products of glass-making reactions, are not in direct contact with the melting batch or molten glass. Their durability is dependent on the following factors:—

1. The softening temperature or "normal" refractoriness.
2. The mechanical strength at normal temperatures.

3. The mechanical strength at high temperatures or " under load " refractoriness.
4. The thermal or reversible expansion.
5. The permanent expansion or contraction at working temperatures.
6. The thermal conductivity and diffusivity.
7. The resistance to abrupt changes in temperature at high and low temperatures or " spalling " resistance.
8. The resistance to abrasion.
9. The resistance to the corrosive action of melting batch and molten glass.
10. The permeability to gases, vapours and molten glass at high temperatures.
11. The changes in properties after prolonged heating.

The relative importance of these factors will naturally vary with the type of furnace and the work it is doing. Refractories such as pots, which are required to hold a considerable weight of glass and are exposed to high temperatures on both inner and outer surfaces must not only be resistant to corrosion and solution but must possess a high mechanical strength at founding temperatures. The founding temperatures necessary for efficient glass production are not so high as those necessary for such metallurgical operations as steel-melting. Glass-melting furnaces seldom exceed a temperature of 1500-1550 C. so that from the temperature point of view alone the conditions are not very severe, but in all cases of exposure of refractories to high temperatures the time factor is of particular importance. The run of a steel-melting furnace does not often exceed two to three months, but in a glass-melting tank-furnace the full heat is maintained for as long, sometimes, as two years and a life of from eight to as much as 30 or 40 weeks is expected from glass-melting pots. From the time aspect, therefore, the conditions are decidedly more stringent in glass furnaces than in those in which steel is melted. A refractory material does not, in general, possess a definite melting point but rather a melting or softening range. As the temperature rises, the finer particles in the matrix or bond begin to soften and a melt is gradually formed in which the coarser and more infusible constituents begin to dissolve and from which new phases, such as *mullite*, crystallise. This process of solution and recrystallisation is accompanied by changes in porosity and density which modify the mechanical properties of the material. The mechanical properties, and to some extent the corrosion resistance, of a refractory material at melting or founding temperatures will be mainly dependent on the ratio of liquid to solid phase present at that temperature and on the viscosity of the liquid phase (or melt) present. During the high-temperature life of the material the viscosity of the matrix will be changed by the gradual processes of solution and recrystallisation and the gradual increase of flux content from absorption of glass. A condition of stability or equilibrium is therefore more rapidly attained in materials of fine and uniform texture.

The refractories used in the manufacture of glass can be conveniently divided into groups as under:—

(a) Silica refractories.
(b) Clay refractories.
(c) Sillimanite refractories.
(d) Carborundum and other " special " refractories.

In subsequent articles the properties and use of these materials will be discussed.

PRACTICAL NOTES ON THE THERMAL ENDURANCE OF GLASS.

Continued from page 223.

Table VI.

Glass No.	Elasticity in kg/mm²		
	Observed.	Calculated.	Difference Per Cent. Obs.—Calc.
19 = 5	7429	7560	—2
25	6632	6619	±0
26	5464	5536	—1
28	6613	7164	—8
29 = 8	6576	6644	—1
34	7090	7459	—5
35 = 7	7195	7186	±0
38 = 6	7402	7796	—4

values to these and certain other oxides. The new factors were:—

Table VII.

SiO_2	40	Fe_2O_3	120
Na_2O	110	CaO	240
Al_2O_3	120	MgO	300

Using these factors, the investigators obtained close agreement between calculated and observed results, the average difference, excepting glass 11, being less than 1 per cent.

COMBUSTION CONTROL.

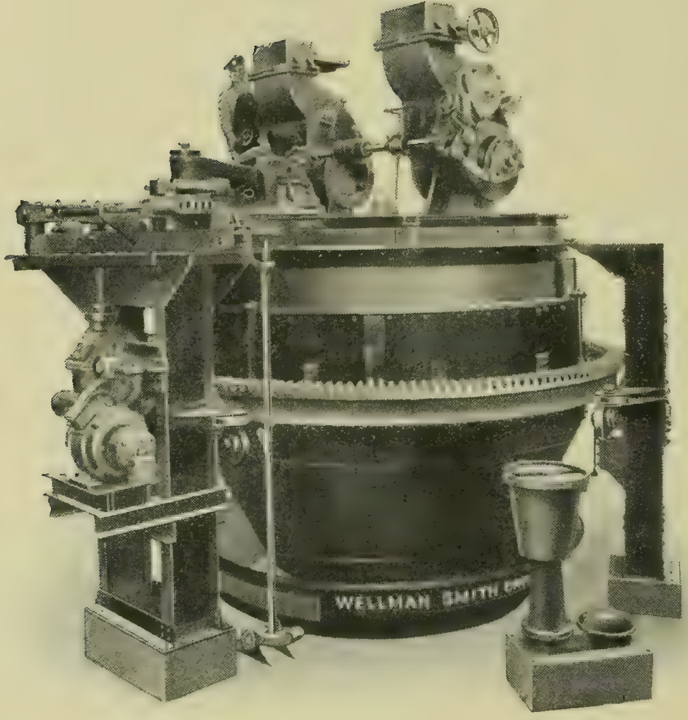
In a paper read before the American Institute of Mining and Metallurgical Engineers, Mr. K. Huessener described a method of combustion control he had adopted with very beneficial results in connection with the operation of open hearth steel furnaces. Due to the similarity between the two, some adaptation of the same methods could doubtless be used on glass furnaces.

By the use of a special though simple regulator, the amount of air admitted to the furnace is automatically controlled so that it always bears a predetermined ratio to the amount of gas entering.

With producer gas the furnace becomes a one-valve control furnace. By admitting more steam to the producer blower, more air is sent to the producer, more gas is produced and automatically the right proportion of additional air is admitted to the furnace by the regulator. An induced-draft fan is used to render the furnace independent of the chimney effect of the checkers and stacks for the supply of air.

The desired ratio between gas and air can be changed at will in order to provide either a neutral, reducing, or oxidising atmosphere in the furnace as desired.

WELLMAN AUTOMATIC GAS MACHINES



These machines have proved to be of the greatest value in Glass Works.

One Glass Works after making exhaustive comparative tests has installed a total of

14 Wellman Producers.

The high efficiency and speed of working is due to the special features described in our booklet for which every Glass Works Manager and Engineer should write.

No. 10 TO GASIFY UP TO 4,000-lbs. COAL PER HOUR.
No. 8 TO GASIFY UP TO 2,600-lbs. COAL PER HOUR.

THE WELLMAN SMITH OWEN ENG. CORP., LTD.

36-38, KINGSWAY, LONDON, W.C.2.
WORKS :: :: DARLASTON, S. STAFFS.

Telephones: HOLBORN 2588/9. *Telegrams:* "PRINCIPIUM, WESTCENT, LONDON."

Relative Value of Carbon Monoxide and Hydrogen as Constituents of Producer Gas.

(Continued.)

By WILLIAM E. RICE.

Rate of Propagation of Flame and Limits of Flammability.

A number of investigators have conducted extensive investigations on the subject of combustion of mixtures of flammable gases with air, and their results show well-defined limits beyond which flame will not propagate itself. For example: Payman* shows that mixtures of a given producer gas and air are not flammable if there be present less than 24.7 per cent. or more than 61.5 per cent. of producer gas. In that case these are the lower and upper limits of flammability. For each mixture of flammable gas with air there is a definite rate of flame propagation, which increases with increasing proportion of flammable gas until a maximum speed is reached, then decreases with increasing proportion of gas until the upper limit of flammability is reached.

TABLE IV.

Limits of flammability, speed mixtures, and speed of flame of gases in producer gas.†

Flammable gas.	Maximum speed mixture. Combustible gas, per cent.	Speed of flame in this mixture, cm. per sec.	Lower limit mixture. Combustible gas, per cent.	Upper limit mixture. Combustible gas, per cent.
Carbon monoxide	50.0	125	16.3	71.2
Hydrogen	38.5	485	6.2	71.4
Methane	9.9	67	5.8	13.3
Ethylene	7.1	142	3.4	14.1

TABLE V.

Limits of flammability and speed of flame in typical producer gas samples.

Producer gas.		Sample No. 1.	Sample No. 2.	Sample No. 3.	Sample No. 4.
CO_2	per cent.	2.35	5.10	6.95	9.15
CO	,,	31.60	27.30	25.40	21.70
H_2	,,	11.60	15.50	18.30	19.65
CH_4	,,	3.05	3.05	3.40	3.40
N_2	,,	51.40	49.05	45.95	46.10
Ratio $CO - H_2$		2.7	1.8	1.4	1.1
Producer gas with air:					
(*a*) Maximum speed mixture ...	per cent.	56.1	55.6	53.8	54.3
(*b*) Lower limit mixture	,,	20.5	19.1	17.8	17.8
(*c*) Upper limit mixture	,,	72.7	72.9	71.6	72.2
Margin of adjustment (c—a)	,,	16.6	17.3	17.8	17.7
Speed of flame in maximum speed mixture cm. per sec.		198	226	239	252

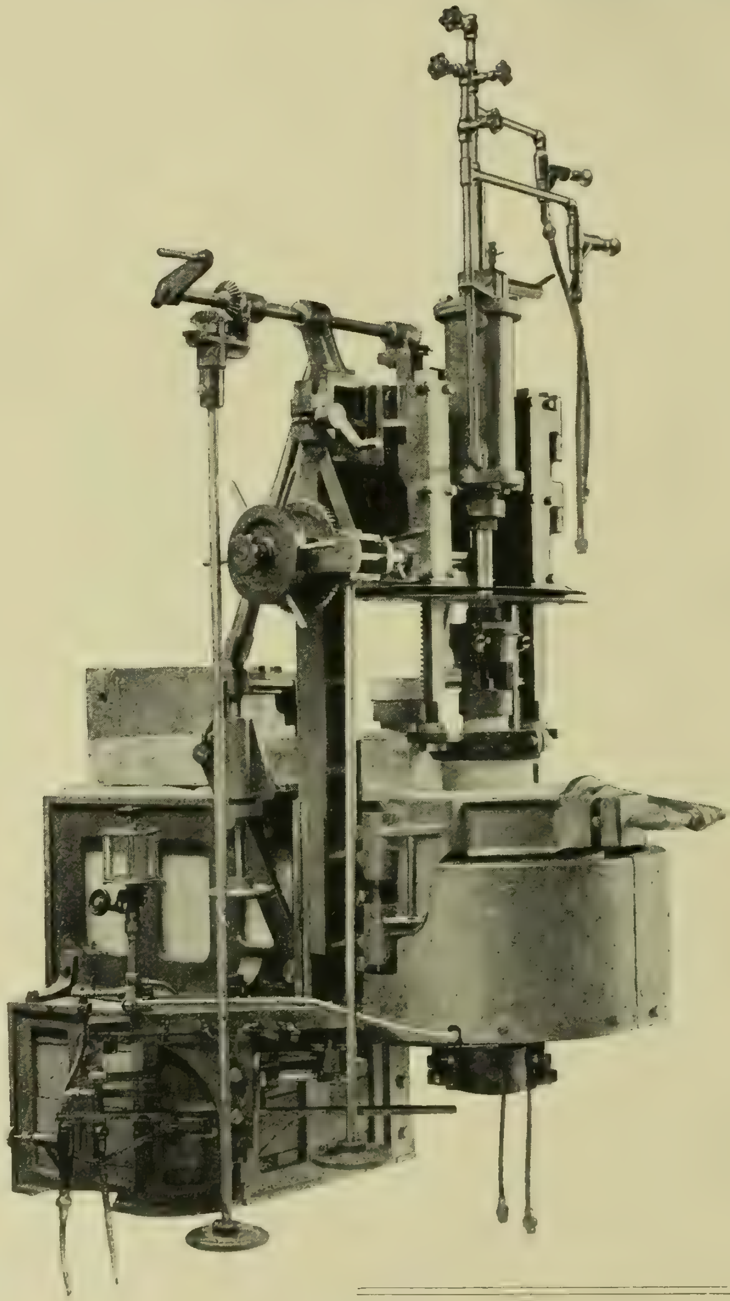
Table 4 gives the upper and lower limit mixtures, the maximum speed mixture and the speed of flame in the maximum speed mixture with air of the simple gases which are constituents of producer gas. The values given are for gases at rest in a horizontal glass tube 1 inch in diameter, but are, nevertheless, useful when considered as comparative figures for determining the relative values of different gases in furnaces. Values differing in magnitude, but having approximately the same ratio, are found, for instance, in larger tubes

---

* Payman, William, Propagation of flame in complex gaseous mixtures. Trans. Chem. Soc., Vol. 115, part 2, 1919.

† Payman, W., and Wheeler, R. V., The composition of gaseous fuels in relation to their utilisation. Fuel, Vol. 1, 1922, p. 185.

The "RANKIN" Automatic Glass Feeder.



RESULTS JUSTIFY CLAIMS.

Claims without justification are futile.

The need for automatic production is admitted by every glass manufacturer. The question is—what mechanism can be installed with the assurance of the best results?

The "RANKIN" record is unrivalled in the Glass Feeder world. Its history is unique. In no instance has a "RANKIN" installation once installed been superseded. On the contrary, wherever it has been adopted, further installations have followed.

The latest proof of this claim is a repeat order for **TWELVE FEEDERS** from a Glass Manufacturing Company, who originally put in one Feeder for comparison with other similar devices. This we believe to be

THE LARGEST INDIVIDUAL ORDER EVER PLACED FOR AUTOMATIC FEEDERS

and represents a great triumph for an All-British Built Feeder.

The mechanism, material and finish are of the highest possible quality. The "RANKIN" Feeder is built for service and will outlast all others.

Demonstrations of the RANKIN AUTOMATIC GLASS FEEDER will be arranged by appointment.

For Illustrations, Descriptive details and terms apply to :

THE RANKIN AUTOMATIC GLASS FEEDER CO.,

1, CHARTERHOUSE STREET, LONDON, E.C.1.

Telegrams : Natiglaso, London. *Telephone Nos. :* Holborn, 140 and 141.

(combustion chambers) or when the gases are in movement as is the case in industrial furnaces.*

By means of weighted averages the same factors for mixtures of the simple gases may be calculated. This has been done for four samples of producer gas and the results are tabulated in Table 5. (These are the same four samples for which other data are given in Table 3.) The speed of the uniform movement of flame in all the limit mixtures, simple or complex, is approximately the same, about 20 centimeters per second under the conditions specified.

These calculations show that increase of H_2 content in producer gas increases the speed of flame, or the rapidity with which the gas burns after entering the combustion chamber and mixing with air, which means that a short, hot flame is produced in the furnace, resulting in unequal heating in the furnace. On the other hand, when the CO is high and H_2 low, the speed of flame is lower and a long flame, completely filling the laboratory, is produced. Thus a further advantage of CO is shown to be due to its maximum speed of flame being only about one-fourth that of hydrogen.

In the operation of many furnaces fired with producer gas the laboratory is completely filled with a long flame which is maintained by slow combustion of the gas in a supply of air less than the amount necessary for complete combustion. However, enough air must be admitted to maintain combustion, therefore the ratio of gas and air must lie within this range.

Payman and Wheeler† state that:

> "A small 'range of adjustment' means that slight variations in pressure of the gas will cause wide fluctuations in the character of the flame and in the distribution of heat throughout it, with consequent inefficiency of any furnace in which the flame is used."

The calculated margins of adjustment (Table 5) show no great variation in favour of either H_2 or Co as they occur in producer gas, thus demonstrating its value for use in the conditions met in metallurgical furnaces.

Dilution by Water Vapour.

Haslam* shows that greater dilution of producer gas is brought about by the presence of undecomposed water than by carbon dioxide. He gives the equation

$$[H_2O] = \frac{(CO_2) \times (H_2)}{(0.096\ L) \times (CO)}$$

in which $[H_2O]$ equals the volume of moisture in the producer gas per 100 volumes of dry gas; (CO_2), (H_2), and (CO) equal the percentages of these gases as determined by the Orsat analysis; and L equals the depth of fuel bed in feet. The equation is based on the results of numerous tests by different experimenters, and has been found to give the amount of water vapour present within 10 per cent. It will be noted that according to the formula an increase in H_2 is accompanied by increased dilution with water vapaur, while an increase in CO is accompanied by decreased dilution with water vapour. In Table 6 are shown the calculated percentages of water vapour in the four samples of producer gas previously used as examples, also the lowering of the flame temperature by dilution with water vapour.

Dilution of the gas with water vapour when the Orsat analysis shows high H_2 content is therefore another reason why a producer gas high in H_2 is less efficient in retort furnaces than one high in CO.

TABLE VI.

Water vapour in producer gas and lowering of flame temperature thereby.

Producer gas.	Sample No. 1.	Sample No. 2.	Sample No. 3.	Sample No. 4.
CO_2 ... ... per cent.	2.35	5.10	6.95	9.15
CO ... ... ,,	31.50	27.30	25.40	21.70
H_2 ... ... ,,	11.60	15.50	18.30	19.65
L = depth of fuel bed ... ... feet	3.5	3.5	7.0	7.0
Volumes H_2O vapour per 100 volumes producer gas ... ... volumes	2.55	8.60	7.45	12.35
Analysis including H_2O vapour:				
CO_2 ... ... per cent.	2.29	4.70	6.47	8.14
CO ... ... ,,	30.81	25.14	23.64	19.31
H_2 ... ... ,,	11.31	14.27	17.03	17.49
CH_4 ... ... ,,	2.97	2.81	3.16	3.03
N_2 ... ... ,,	50.12	45.17	42.76	41.03
H_2O ... ... ,,	2.50	7.91	6.94	11.00
Theoretical flame temp. ... ... °F.	3315	3175	3205	3050
Theoretical flame temp. of dry gas† ... ... ,,	3375	3320	3330	3240

† (a) Table 3.

Action of Hydrogen Flame on Clay Refractories.

In a discussion of surface combustion, Bone and Wheeler† state than when a mixture of flammable gas

---

* Mason, Walter, and Wheeler, R. V., The propagation of flame in mixtures of methane and air, Trans. Chem. Soc., Vol. 117, part 2, 1920.

† Payman, W., and Wheeler, R. V., work cited.

* Haslam, R. T., Producer gas. Ind. and Eng. Chem., Vol. 16, No. 8, Aug. 1924, pp. 782-4.

† Bone, W. A., and Wheeler, R.V., The combination of hydrogen and oxygen in contact with hot surfaces. Phil. Trans. Roy. Soc., Vol. A, 206, pp. 1-67, 1906.

PARKINSON & SPENCER, Ltd.

Ambler Thorn Fireclay Works,
HALIFAX, YORKSHIRE.

ESTABLISHED
1800.

Telephone : No. 1207.
Telegrams : Parkinson & Spencer, 1207 Halifax

Manufacturers of Refractory Goods of every description for the Glass industry, viz :

GLASS-HOUSE POT CLAY, FIRE CLAY, FIREBRICKS, TANK BLOCKS, BINDERS, etc.

Our Tank Blocks are unsurpassed for quality and durability.

WE SPECIALIZE IN BEST POT CLAY MATERIAL.

New Plant recently erected for the cutting and dressing of Tank Blocks to any dimensions.

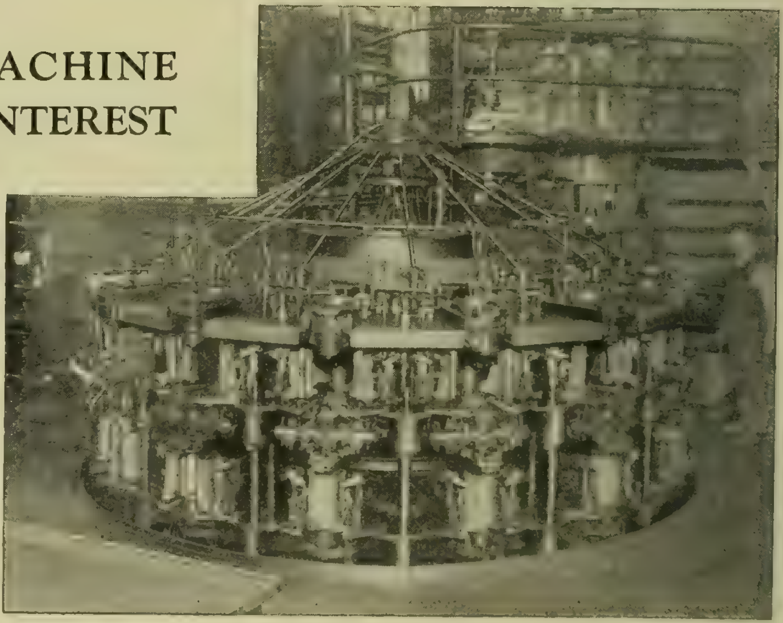
FAVOUR US WITH YOUR ORDERS AND YOU WILL BE SATISFIED WITH RESULTS.

NEW GRAHAM MACHINE
CREATING GREAT INTEREST

Offers unusual advantages because of improved construction. Eliminates intermittent rotation which causes wear and tear through jerking. Continuous rotation permits larger production and lower operating costs.

Flexibility of operation appreciated. Produces both narrow and wide mouth bottles in wide range of sizes. Makes push-up bottoms without separate operation.

Three sizes of same construction.
AZ Machine, 15 blank and 15 blow molds
AY Machine, 10 blank and 10 blow molds
AY6 Machine, 6 blank and 6 blow molds
Molds and mold operating parts are interchangeable.



AZ Flow Type—Maximum Speed 72 Bottles per Minute

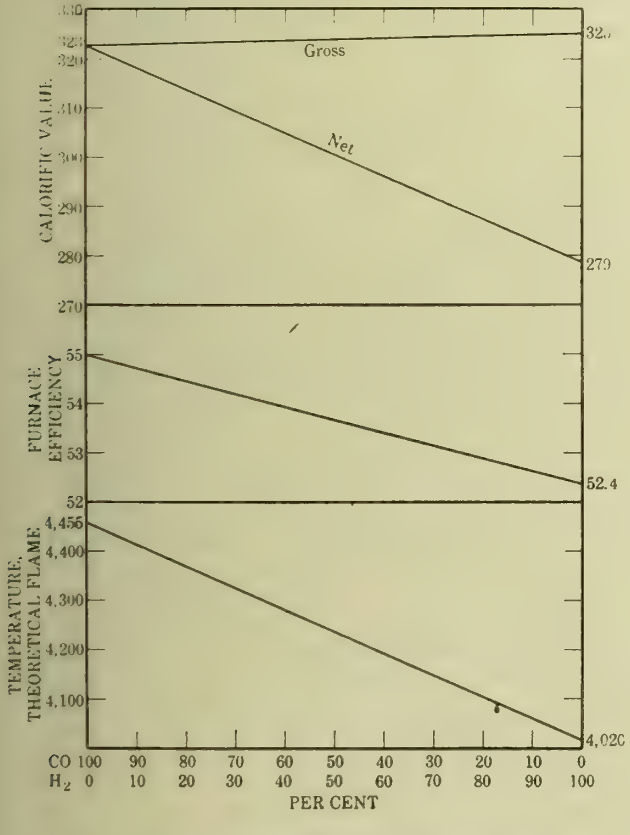
THE OWENS BOTTLE COMPANY—TOLEDO, OHIO, U. S. A.

Ask us for illustrated catalog, giving complete information.

with air is brought into contact with a porous refractory incandescent solid a greatly intensified combustion takes place because of absorption of the combustible gas and probably oxgen, whereby the gas becomes " activated " (probably ionised) by association with the surface. As pointed out by Payman and Wheeler*, while in special adaptations this surface combustion may be advantageously utilised, in metallurgical furnaces, where the catalytic surfaces are the walls, and in some cases refractory vessels containing the charge, the intense local heat produced may prove to be harmful to the refractory material. Hydrogen is by far the most susceptible of the combustible gases to surface combustion, therefore it follows that its presence in large amounts in producer gas must have the effect of shortening the life of refractories.

Conclusions.

It has been shown that carbon monoxide possesses an advantage over hydrogen as furnace fuel because of its higher net calorific value, the greater radiation from its flame, and its higher flame temperature. These differences are represented graphically by curves in the accompanying figure, which show the gross and net calorific values, furnace efficiencies, and flame temperatures of mixtures of the two gases varying from 100 per cent. CO with no H_2 to 100 per cent. H_2 with no CO, when burned with just sufficient air for complete combustion. Hydrogen has been shown to be an undesirable constituent of producer gas, because of its short flame and the deleterious action of its surface combustion on furnace walls and retorts. It has been shown that the presence of a high proportion of hydrogen indicates dilution of the gas with undissociated water vapour.



Calorific values, furnace efficiencies and flame temperatures for mixture of carbon monoxide and hydrogen

All these factors indicate the desirability of operating the gas producer so as to make a gas of the requisite calorific value containing a maximum of CO and a minimum of H_2.

Clement, Adams, and Haskins* found in a series of laboratory tests that

" . . . the percentage of carbon monoxide formed depends upon the temperature and the time of contact of gas and carbon."

That is to say, when velocity of gas through the producer is high it is necessary to maintain the fuel bed at a high temperature to obtain a gas high in CO and low in CO_2 and H_2.

Bone and Wheeler's† tests proved that at low temperatures the predominating reaction between steam and carbon is

$$C + 2 H_2O = CO_2 + 2 H_2,$$

and that at higher temperatures the reaction

$$C + H_2O = CO + H_2,$$

predominates; or as more steam is added to the blast the temperature is lowered, accompanied by increased production of CO_2 and H_2 and decreased CO. When the gas is sent hot from the producer to the furnace the steam to the producer should be a minimum.

The methods of operation for the production of high carbon monoxide are thus summed up by Rambush:‡

1. The fuel surface exposed should be as large as possible.
2. The time of contact between the fuel and the gas is made as high as possible.
3. The temperature should be maintained as high as practicable.

To maintain a high temperature the amount of steam added should not be more than just enough to keep the fuel bed in proper condition—that is, prevent excessive clinker formation. The high temperature of the gas leaving the producer will not result in excessive loss of heat by radiation in plants where the producers are situated immediately adjacent to the furnace.

Other details of gas-producer operation, especially concerning temperatures in fuel beds, are given in Bureau of Mines publications.§

It has been the object of this paper to present briefly the reasons for the greater furnace efficiencies resulting from the use of producer gas high in carbon monoxide and low in hydrogen. The material is not original with the writer, and it is hoped that the references given will be of value to those interested in further study of the problem or in efficient operation of producer gas plants.

(*Continued on page* 243.

---

* Payman, W., and Wheeler, R. V., work cited.

* Clement, J. K., Adams, L. H., and Haskins, C. N., Essential factors in the formation of producer gas. Bureau of Mines Bull., 7, 1911, 56 pp.

† Bone, W. A., and Wheeler, R. V., An investigation on the use of steam in gas-producer practice. Work cited.

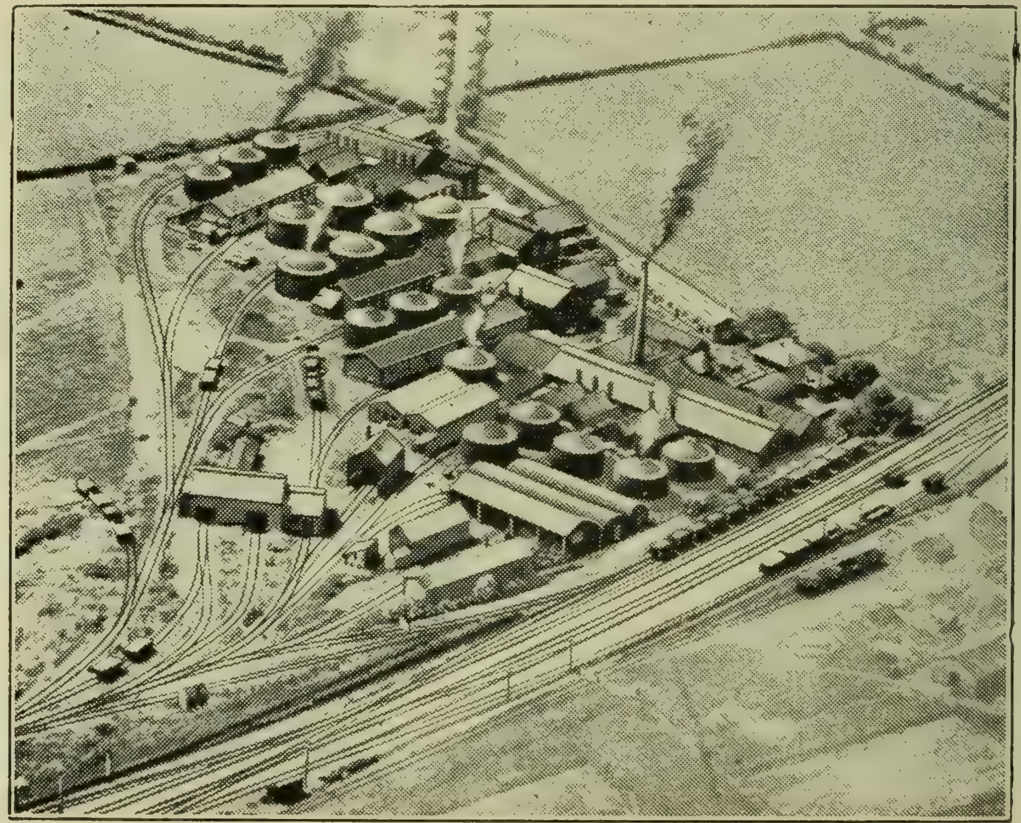
‡ Rambush, N. E., Modern gas producers. New York, Van Nostrand Co., 1923, p. 14.

§ Fernald, R. H., Smith, D. C., Clement, J. K., and Grine, H. A., Incidental problems in gas-producer tests. Bull. 31, Bureau of Mines, 1911, 29 pp.; and Fernald, R. H., Operating details of gas producers. Bull. 109, Bureau of Mines, 1916, 74 pp.

THE MOST DURABLE **BRICK**
MADE FOR **GLASS FURNACES.**

STEPHENS SILICA "C"

EXTREMELY REFRACTORY, TOUGH AND DURABLE.



VIEW TAKEN FROM AN AEROPLANE.

Kiln Capacity 1½ Million Bricks. Works Cover over 9 Acres.

SUPER SILICA CEMENT for setting SILICA BRICK.

Used by most of the principal GLASS WORKS.

STEPHENS & CO., KIDWELLY.

The Society of Glass Technology.

The Ninth Annual General Meeting of the Society of Glass Technology was held in the Department of Applied Science of the University of Sheffield, on April 21st. Prior to the meeting, some thirty members lunched together at the King's Head Hotel. The agenda before the Council had evidently been lengthy, for the members of the Council were among the last to arrive, and the time proved all too short for anything in the nature of speeches at the luncheon, which was quite informal.

At the Annual General Meeting, Mr. Walter Butterworth, senior, M.A., was elected President, in succession to Mr. T. C. Moorshead. The other officers elected to fill vacancies were :—

Vice-Presidents — Messrs. F. F. S. Bryson, M.B.E., M.A., B.Sc., and S. English, D.Sc., A.I.C.

Ordinary Members of Council—Messrs. R. S. Biram, E. A. Coad-Pryor, B.A., A. Cousen, M.Sc., A.I.C., W. J. Gardner, C. J. Peddle, M.B.E., D.Sc. Mr. Joseph Connelly was re-elected General Treasurer, Mr. F. C. Flint was appointed American Treasurer, and Prof. W. E. S. Turner, D.Sc., was re-elected Honorary Secretary.

The statement of accounts, and the ninth annual Report of the Council were adopted. The Report showed that although there was a slight shrinkage of membership in this country, there was a very definite increase in the overseas membership, and the Society possessed members in no fewer than nineteen different countries. Fifty-five members were elected during the year.

In the course of his address, Mr. Butterworth alluded to this slight decrease in British membership, and appealed to every member to see that the number should be maintained, as the Society was becoming of great importance, linking up glass manufacturers all over the world. During its ten years of life the Society had had a remarkable career; it had served a very good purpose, and glass manufacturers were now working together much more than before. He believed, and hoped, that a year of unusual importance lay ahead. There was a possibility of a Convention of the Glass History being held in London, with an exhibition run in conjunction, and he appealed to all members to unite their efforts and do their utmost to make the convention a great success, and impress its importance on all connected with the industry.

Past-Presidents had been men of distinction and learning, and Mr. Butterworth stated that, although he could not lay claim to any scientific training, yet he would endeavour to be of some service to the Society.

Professor Turner moved a hearty vote of thanks to the retiring President, Mr. T. C. Moorshead, who had very ably conducted the affairs of the Society in the past year. The work allotted to the " first-class passenger " had not always been as slight as that passenger (Mr. Moorshead) had implied in his few remarks. A vote of thanks was accorded to the retiring officers, and the authorities of the Sheffield University were specially thanked for the excellent accommodation afforded free of charge for meetings, for offices, and library, as the headquarters of the Society are at Sheffield.

At the ordinary meeting, which followed, one collective member and eleven ordinary members were elected. These included two from Peru, three from the United States, one from Japan, and one from Norway.

Several papers were presented at this meeting.

The first of these, entitled " **Notes on the Devitrification of a Lead Borate Glass,**" by C. J. Smithells, M.C., D.Sc., was read by Mr. B. P. Dudding.

Specimens of tungsten filaments were prepared for microscopic examination by embedding them in a fused lead borate glass held in a brass cup, and subsequently grinding to the required section after the glass had solidified. The glass softened at a temperature of about 200°.

After a specimen had been polished it was usually etched with alkaline potassium ferricyanide solution for about 15 seconds to develop the structure in the filament. Examination of a number of specimens which had been prepared at different times during the last five years showed that in certain cases a number of crystals were visible in the glass when viewed under the microscope with vertical illumination. These crystals were not visible in polished specimens, but only after etching. Several slides, illustrating the appearance of the crystals in various specimens were shown.

An examination of a number of specimens which had been stored at room temperature revealed the fact that they could be divided roughly into groups, showing various degrees of devitrification depending upon the age of the specimen. Specimens less than two years old showed no sign of crystals on etching, but after 2½ years small crystals were visible. Crystallisation appeared to begin where the glass was in contact with the brass or tungsten, or in a region of deep scratches. Almost the whole of the glass of specimens from three to five years old had devitrified, and hexagonal plates could generally be found in the older specimens. These crystals of a hexagonal system were probably lead borate.

The observations appeared to illustrate a simple case of slow crystallisation at room temperatures, and indicated the possibility of detecting devitrification in other glasses by means of a suitable etching reagent.

An interesting discussion followed, in which Prof. W. E. S. Turner, Messrs. F. Winks, H. W. Howes, E. A. Coad-Pryor, Dr. C. J. Peddle, Dr. S. English, and Miss V. Dimbleby took part.

The second paper, by J. F. Hyslop, was entitled " **A Note on Some Factors Governing the Resistance of Pots to Glass Attack.**"

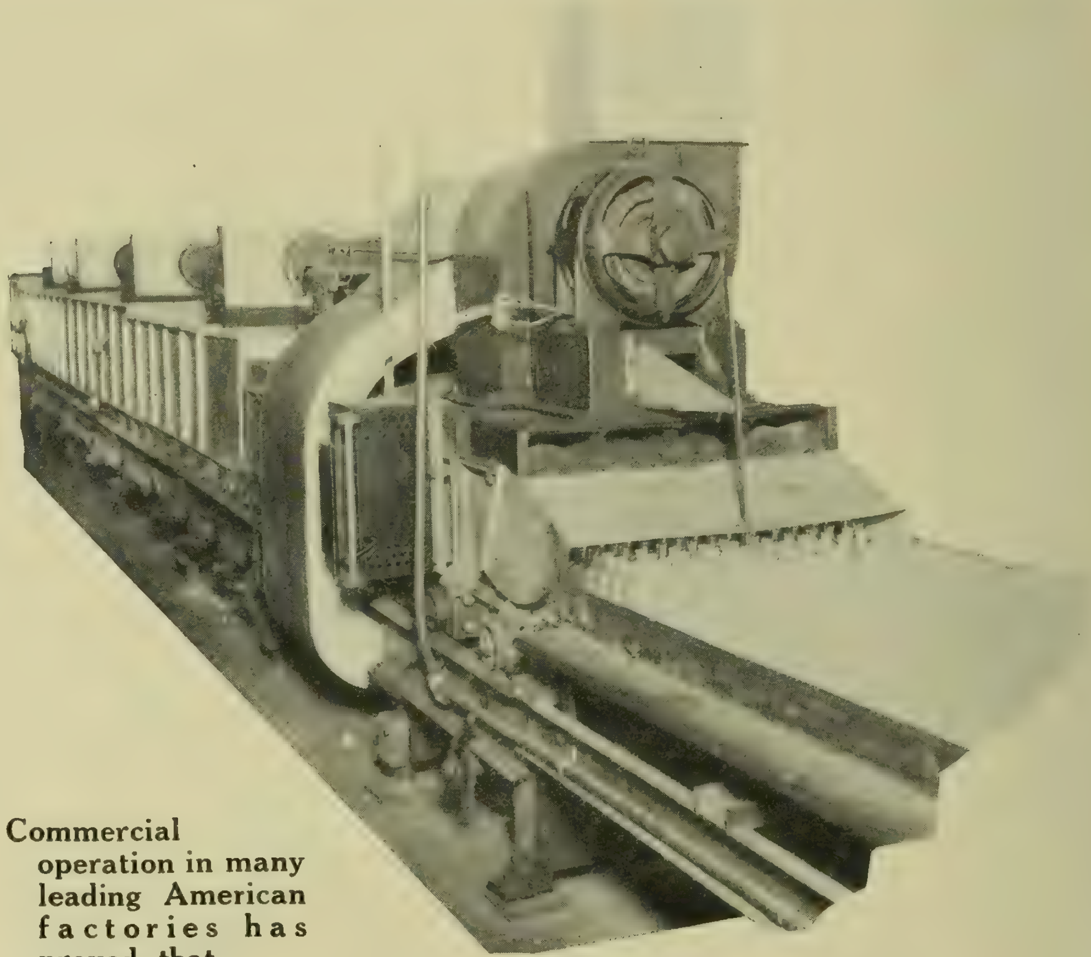
Two series of pots, K1 and K2, had been found to give very different results in use. The former series

Another Scientific Development

THE HARTFORD LEHR

IS CREATING

A NEW STANDARD OF ANNEALING



Commercial operation in many leading American factories has proved that

THE HARTFORD LEHR

1. Gives **"GRADE A" ANNEALING AT ALL TIMES**
2. Saves FUEL (as high as 85% saving has been shown).
3. „ WARE (No "Lehr Loss").
4. „ LABOUR.
5. „ SPACE.
6. „ UPKEEP EXPENSE.

The British Hartford-Fairmont Syndicate Ltd.

142 - 143 Audrey House, Ely Place, London, E.C.1

"HARTFORD" AUTOMATIC FEEDERS - FORMING MACHINES - LEHRS

gave exceptionally long life, and showed no signs of excessive wear when removed from the furnace, while the other series showed convincing signs of severe attack, although the length of life was satisfactory. A standard alkali-lead oxide glass was used in each case.

Small sections of the pots were ground and polished, and on exposure to a beam of X-rays each crystalline phase in the materials gave its own precise diffraction pattern. The constituents present in the materials were identified in this way.

The results obtained showed that the matrix was a more potent factor than the grog in determining the rate of attack of a pot. A high alumina content of the clay was necessary in order to obtain a protective layer. If the fired clay had high percentage of mullite it would tend to form with the glass, an intermediate layer of high viscosity, preventing rapid chemical reaction. In the case of a composite refractory, such as a pot, the evidence strongly suggested that a high mullite content was essential in the matrix of the body.

Messrs. W. J. Rees, E. A. Coad-Pryor, B. P. Dudding, and Prof. W. E. S. Turner took part in the discussion which followed.

Mr. E. A. Coad-Pryor, B.A., contributed the third paper, entitled "**The Behaviour of Sillimanite in Tank Furnaces.**"

Comparative tests had been made by the speaker, using sillimanite blocks of standard size (8″ × 18″ × 24″) made by two separate firms. These blocks were built into both sides of a tank furnace on the flux line between the filling-on end and the bridge. The tank was run for 24 weeks, melting an ordinary flint glass, and twenty tons of glass were drawn per day. When the furnace was put out the blocks were carefully examined, being removed from the surrounding fire-clay blocks. It was found that the particular sillimanite blocks used had been corroded more severely than those made of fireclay, in adjacent positions. All of the sillimanite blocks exhibited this greater corrosion.

Some discussion followed, in which Messrs. E. Meigh, W. J. Rees, and H. W. Howes took part, Mr. Rees maintaining that the results recorded by the author did not represent the possibilities of recent well-made sillimanite blocks.

The fourth paper, entitled "**The Detection of Small Amounts of Selenium in Glass,**" by J. D. Cauwood, M.Sc., and E. J. C. Bowmaker, was read for the authors by Mr. A. Cousen.

Dragendorff's method for the qualitative detection of selenious acid had been thoroughly investigated by the authors, who then applied it to the detection of small quantities of selenium in glass. Working details of a course of procedure which had been proved to be satisfactory were given.

A fifth paper, by J. T. Howarth, M.Sc., and Prof. W. E. S. Turner, on the "**Purification of Sand,**" was taken as read, owing to lack of time.

THE NEXT MEETING.

London, June 1st and 2nd, 1926.

London has been chosen as the centre for the next meeting of the Society, which will extend over two days —June 1st and 2nd.

On the afternoon of Tuesday, June 1st, the meeting will be held in University College, Gower Street, when members will have the privilege of attending a demonstration and lecture by Professor Sir W. Flinders Petrie, the famous Egyptologist. Members of the Stained Glass Association, of America, who will be visiting this country at the time, are invited to this meeting, and it is hoped that the British Society of Master Glass Painters will also be well represented.

The Annual Dinner is to take place on the evening of June 1st, at the Hotel Cecil, when the touring members of the American Association will be entertained by the Society of Glass Technology. The Council invite members of our Society to act as individual hosts, one member to be responsible for the entertainment of one visitor. Already, several members have responded to the Council's call, but twenty-seven guests are expected, and the secretary will be pleased to receive further offers of hospitality for the dinner.

On the Wednesday morning the members will proceed to Wembley, where, by the courtesy of the directors, a visit will be paid to the Osram G.E.C. Glass Works, and to the Research Laboratories of the General Electric Co., Ltd. After luncheon at the Laboratories, a meeting will be held in the Library of the Research Department, when several papers will be presented.

V. D.

FURTHER DEVELOPMENTS
IN
FOSTER PYROMETERS

Several new forms of Pyrometers, which will be of interest to Glassworks engineers, are described in a new catalogue, just ready.

Ask for Book No. 42S.

FOSTER INSTRUMENT CO.,
LETCHWORTH, HERTS.

"The Pyrometer People."

Telephone: Letchworth 26.
RESILIA
Telegrams: "Resilia, Letchworth."

TELEGRAMS:
"GLASMACHIN, ESTRAND, LONDON.
CABLES:
"GLASMACHIN, LONDON"
CODE:
BENTLEY'S.
TELEPHONE:
CENTRAL 5985.

C. SAXTON, A.M.I.E.E., M. IRON AND STEEL INST., Etc.

CONSULTING ENGINEER

Talbot House,
Arundel Street,
Strand, London, W.C.2.

BOTTLE MOULDS

ORDER YOUR MOULDS FROM

E. LUNN & Co., MOUNT STREET, GLASGOW.

Largest MAKERS of MOULDS in the UNITED KINGDOM

Quick Deliveries and Complete Satisfaction Guaranteed.

MOULDS FOR ALL TYPES OF MACHINES SUPPLIED

ALL MOULDS MADE OF CHILLED CASTINGS ONLY.

Telephone—
WESTERN 2792.

Telegrams—
GLASMOLD, GLASGOW.

ONE OF OUR RECENT TESTIMONIALS—

"We have one set of Ordinary Round Quart Moulds which you supplied to us which have been working for 2½ years. These are still in perfect condition, showing no cracks or any other flaw in the metal. They have been working almost continuously for the above period, only being off the machines for a week or two at a time. We have also other moulds in Square, Oval and special shapes which have been working quite as long as the Ordinary Round Quarts, although not so continuously, and these also are in perfect condition. We have always found your moulds more satisfactory than any others, and the metal you use is much more durable than any supplied by other firms."

Reference on our Testimonial File: A.B. 91.

Trade "TWENTY MULE TEAM" Mark

Granulated

BORAX

Specially refined for

ENAMELLERS AND POTTERS

BRITISH MANUFACTURE.
Guaranteed 99·50% pure.

Entirely free from phosphates.

BORAX CONSOLIDATED LTD.
16, Eastcheap, LONDON, E.C.3.

TRADE NOTES.

At the time of going to Press the full effects of the strike have not yet been experienced by the glass works. Many have fairly large stocks of fuel and raw materials on hand and the staffs have not yet been interfered with. One of the main difficulties is that connected with the delivery of bottles to customers. From enquiries made at several factories some expect to carry on, however, for the time being, whilst others are taking the opportunity of effecting repairs to furnaces and equipment.

◆ ◆ ◆

There has been a heavy call on refractory block and brick makers to get supplies of materials delivered to the glass works.

◆ ◆ ◆

The forty-fourth Annual General Meeting of the Pottery and Glass Trade's Benevolent Institution will be held at 3, Dyers Buildings, Holborn, London, E.C.1, on May 12th at 7 p.m.

◆ ◆ ◆

The nett profits of Webb's Crystal Glass Co., Ltd. for the year 1925 amounted to £14,715 an increase of £13,770 over the previous year. £3,000 was placed to reserve and a dividend of 9 per cent. (less tax) on the ordinary shares and 3.262 per cent. (less tax) on the deferred shares was declared.

◆ ◆ ◆

Owing to a difference in opinion as to the amount by which the duty on imported window glass was to be increased, both chambers of the Swedish Riksdag decided to take a combined vote, with the result that the new duty is fixed at 12 oere per kilo for the large sizes and 10 oere per kilo for the smaller, being an increase of 3 oere in each case, according to Reuter.

◆ ◆ ◆

The eighteenth Annual Report of the Owens Bottle Company, covering the year ending December 31st, 1925, shows a net profit of $5,051,050. For the preceding five years the average net profit was $3,283,453.

◆ ◆ ◆

The report mentions that the two ten arm AY or flow type machines with auxiliary equipment ordered by the All Russian Syndicate of Silicate Industries have been shipped during 1926.

◆ ◆ ◆

On Tuesday April 13th the new Hartford lehr was put into operation at the Rockware Glass Syndicate's factory at Greenford. Since then the lehr has been inspected by many glass manufacturers all of whom have expressed the greatest interest and enthusiasm for this new equipment. One well known manufacturer very neatly summarised the installation as a " drawing room affair."

On April 20th a meeting was held in the Caxton Hall, Westminster, to call attention to the decision of the Board of Trade refusing to acknowledge a prima facie case for reference to a Committee to enable the British Flint Glass trade to establish its claim to " Safeguarding." Representatives of the Trade Union chiefly concerned as well as some of the leading manufacturers and the Members of Parliament for the glass making districts, addressed the meeting and a resolution was passed requesting the President of the Board of Trade to receive a deputation in order that the whole facts relating to the conditions which obtain in the trade may be placed before him.

The meeting was interrupted several times, chiefly on account of the Chairman's decision to allow only those associated with the glass trade to speak and there were several statements to the effect that the meeting was " packed."

◆ ◆ ◆

It is stated that Czechoslovakian competition has been particularly disastrous to the Latvian glass industry.

◆ ◆ ◆

We are advised by the British Hartford Fairmont Syndicate, Ltd., Audrey House, Ely Place, London, E.C.1, that Mr. Ed. Miller, the head of the Miller Machine and Mold Works, Columbus, Ohio, for which they are the European Representatives, intends sailing for Europe on May 16th. During his stay in Europe, Mr. Miller will make his headquarters at the above address.

◆ ◆ ◆

The Annual Dinner of the Society of Glass Technology will be held at the Hotel Cecil, London, on June 1st. It is hoped to have about twenty-seven members of the American Stained Glass Association as guests.

◆ ◆ ◆

On Wednesday, June 2nd, the Directors of the General Electric Company have invited the Society to visit their glass works at Wembley and also their extensive Research Laboratories.

◆ ◆ ◆

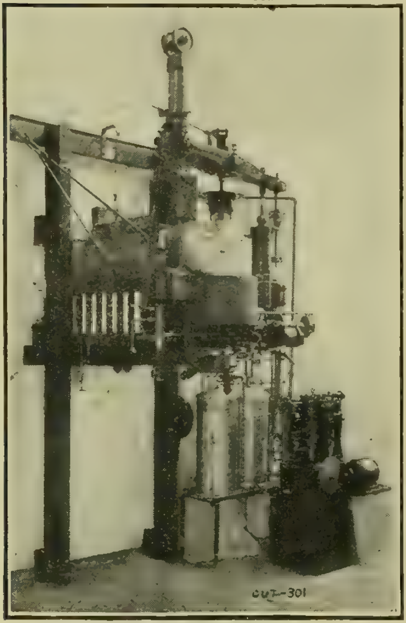
Over 10,000 men employed at Messrs. Brunner Mond's works have refused to obey the instructions to strike.

◆ ◆ ◆

Mr. V. Mulholland of the Hartford Empire Company sailed for America on May 1st.

◆ ◆ ◆

The deposits of manganese found near Kimberley, South Africa, are now being actively developed. The ore contains from 42-58 per cent. metallic manganese, no phosphorus, 1.75-7.00 per cent. silica and 3.25-10.9 per cent. iron.



MODEL KFO.

Latest Miller Feeder

PROGRESSIVELY DEVELOPED SINCE 1907.

By arrangement with **The Morgan Crucible Co., Ltd., Battersea,** a stock of all refractory parts for our feeders is now kept in London.

WILLIAM J. MILLER, Inc., SWISSVALE, PA., U.S.A.

London Office : **366, Strand, London, W.C.2.**

Tel. No. : Regent 5647.

Cables : Autoglasma, Rand, London.
Autoglasma, Pittsburg, Pa.

MOULDS

YOU ARE BOUND to improve the quality and output of your bottles and jars if you use **GOOD MOULDS.**

We supply moulds having the highest possible workmanship and finish. They are produced from the best crucible chilled castings and are machined throughout to precision gauges by practical mouldmakers.

Our service of quick deliveries and guaranteed accuracy in all respects is backed by **LONG PRACTICAL EXPERIENCE.**

We specialise in mould equipment for **LYNCH, MILLER and O'NEILL** automatic machines but any and all types of moulds are undertaken.

No Order too Large. No Order too Small.

We also supply Glassworks patterns and crucible iron castings of all descriptions.

JOHNSON RADLEY & SONS, Ltd.,
Chesney Works,
Hunslet, Leeds.

Telegrams—MOULDS, LEEDS
Telephone—LEEDS **21354.**

Now Ready!

Volume II

Industrial Furnaces

By

W. TRINKS, M.E.

Fuels, Furnace Types and Furnace Equipment; Their Selection, and Influence Upon Furnace Operation.

The ONLY BOOK *in* ENGLISH *available on this important subject.*

405 PAGES. 292 FIGURES.
27/6 net (VOL 1, 22/6 net)

GLASS PUBLICATIONS LTD.,
TALBOT HOUSE,
ARUNDEL STREET, STRAND,
LONDON, W.C.2.

The Use of Compressed Air—*Continued.*

By ROBERT WILSON.

Cooling Water for Air Compressors.

The modern practice, for all but the very smallest sizes of air compressors, is to provide a water jacket around the air cylinder, and also in such spaces as can be utilised for a similar purpose in the cylinder covers. When cold water is circulated rapidly through these jackets the temperature on the jacket side of the metal of the cylinder and covers is maintained lower than would be possible if the outside of the metal were merely exposed to the atmosphere, and, consequently, the rate of flow of heat through the metal is considerably increased.

The transfer of heat through the metal to the water is dependent upon the difference between the temperature of the side of the metal exposed to the heat of compression and that of the side of the metal acted upon by the water, and as the latter will be influenced by the mean temperature of the cooling water in the jackets it follows that the rate of flow of heat will increase as the mean temperature of the cooling water decreases. If the water entering the jacket is comparatively warm or if, due to the flow being at a low rate, the mean temperature of the water in the jacket is high, then the difference in temperature between the respective sides of the metal will be reduced and the quantity of heat transferred will also be reduced.

The heat transferred through the metal is carried away by the water, and, usually, is dissipated, since the rise in temperature is never high enough to give to the warm water leaving the jackets any special value from a commercial point of view. The increase in temperature through the jackets, when the initial temperature of the water is from 50° F. to 60° F. should not exceed 20° F., and should be maintained lower than this where a plentiful supply of water is available. The same increment of temperature, when the water available is at an initial temperature higher than stated above, would create for a higher mean temperature in the jackets, which in turn would reduce the temperature gradient through the metal, and, consequently, lower the rate of heat transfer. If, therefore, the mean temperature in the jackets is to be preserved approximately constant, the temperature increment should decrease as the initial temperature of the water increases. This can only be secured by increasing the rate of circulation of the water through the jackets.

The problem of properly withdrawing the heat from the air during compression is made more difficult by reason of the short period of time in which the cooling must be done. The time occupied by each compression stroke in an air compressor making 250 revolutions per minute is only about *one-eighth* of a second, but the time available for reducing the quantity of heat produced by compression is even less than this small fraction of time, for the reason that the metal, at the commencement of the stroke, is at a higher temperature than that of the air drawn into the cylinder, and, consequently, no heat transfer can take place from the air to the metal until the air has attained to a temperature higher than the mean temperature of the metal. Therefore, the cooling effect of the water jacket operates only in the latter half of the stroke; and when to this difficulty is added the fact that only the outside layers of the air being compressed come into contact with the cooled surfaces, it will readily be apparent that cooling by water-jacketting can never be very effective, and that, in the time available, only a small fraction of the heat equivalent of the work done in producing heat during compression can be transferred to the water.

Water-jacketting, however, is the only means available for cooling purposes in single-stage compressors. Multi-stage compressors, in addition to the usual water-jackets are provided with inter-coolers between the stages of compression, and as these inter-coolers are, virtually, intermediate receivers, having facilities for water circulation, and in which the air travels comparatively slow while in contact with the cooled surfaces, much more effective cooling can thus be obtained.

Cooling Systems.

Since, however, the single-stage type of compressor is that used mostly in glass works, it must not be supposed —because water-jacketting is relatively ineffective in withdrawing the heat of compression—that consideration of such cooling effect as is obtained is unworthy of attention and acute consideration. The difficulties attaching to the cooling of single-stage machines are alone sufficient to point the necessity to make the best use of the only means available, and the one way in which this can be secured is by the use of a continuous supply of cold water rapidly circulating throughout the jackets. As already pointed out, the lower the temperature of the water passing through the jackets, the greater will be the difference in temperature between the cylinder and jacket sides of the metal, and, consequently, the greater the rate of heat transfer through the metal to the water.

This is not always fully appreciated by the user, for reasons which, to him, appear very well founded, the principal of these being that rarely can a further use be found for the water after it has passed through the compressor; and, his business instincts revolting against what he supposes to be avoidable waste, he adopts means of collecting the water as it leaves the compressor and of again circulating it through the jackets. The user is to be sympathised with in these ideas, for besides the wastefulness which he supposes is being practised when the water leaving the compressor is run to waste, he no doubt feels that, to some extent, a compressor is similar to a gas or internal combustion engine, and that the methods practised for the cooling of engines of these types can be applied to an air compressor.

The cooling arrangements for internal combustion engines are, however, of much less importance than are those required for air compressors. In the former, the object of the cooling water is to keep the temperature of the metal from becoming so high as to interfere

New DEVELOPMENTS in
GLASS FURNACES:

TEISEN New Wasp-Shape continuous Tank Recuperative Type

with longitudinal travel of flame. The most up-to-date Machine Tank, possessing Stream line features and securing:

High Efficiency
Long Life
Constancy of Temperature
Easy Means of Regulation
Good Access to Repair to the Throat

TEISEN New T Shape Cross Flame Tank Regenerative Type

For the largest capacities securing:

High Output with Economy of Fuel

by better utilisation of the flame. Designed on the principle of the Modern Open Hearth Furnace.

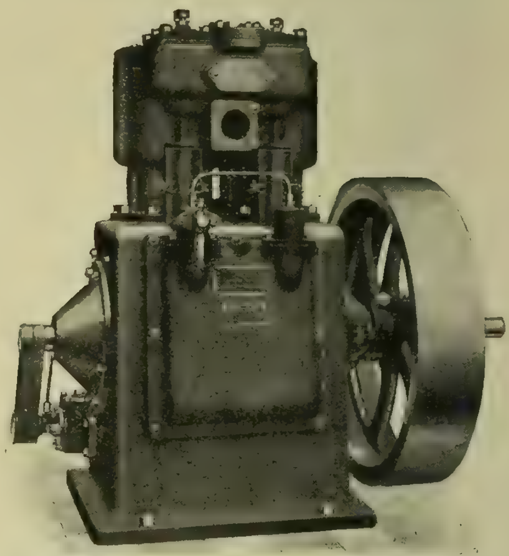
LET ME STUDY YOUR PROBLEMS.

Individual Attention to all Furnace Matters.

Write Now—

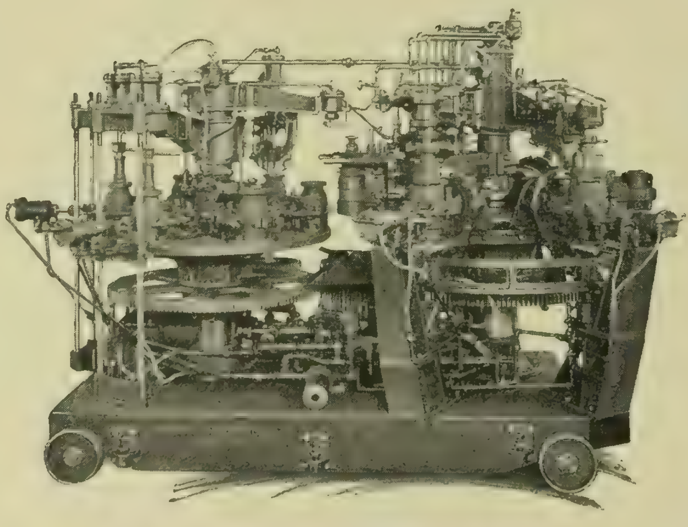
Th. TEISEN, C. E.
Furnace Engineer,
20a, Temple Street,
BIRMINGHAM.
'Phone—Central 1806. *Cables*—TETE, BIRMINGHAM

"BROOMWADE"



AIR COMPRESSORS
BRITISH AND BEST
FOR ALL DUTIES.

BROOM & WADE, Ltd., HIGH WYCOMBE.



The New O'Neill No. 44 Blowing Machine.

A well built, high speed blowing machine with a range from 6 oz. to 40 oz. in capacity. Operating speeds up to 23 per minute depending on the class of ware being made. Have our London representative give you the details.

THE O'NEILL MACHINE CO.,
TOLEDO, OHIO, U.S.A.

LONDON OFFICE: 10 SAVOY ST., STRAND, LONDON, W.C.2.

with the good running of the machine, and is not intended to limit appreciably the temperatures in the cylinder. Thus, the water can be comparatively hot and still achieve the object intended. Many such machines, as is well-known, operate on the thermo-syphon system, whereby circulation is induced by one section of the water being heated to a temperature which causes the heated particles to ascend and allows of particles of colder water flowing in to take their place. This system, while good enough for some gas and oil engines, is quite unsuited for an air compressor, since the heat necessary to secure circulation would be much too high to exercise any appreciable cooling effect on the air being compressed.

In an air compressor the object of the cooling water is to keep down the maximum temperature attained in the cylinder, and as the maximum temperature is determined by the initial temperature at commencement of compression, which in turn is influenced by the mean temperature of the metal, it is quite apparent that much greater consideration must be given to the cooling water of an air compressor than to that required for an internal combustion engine. The effect of high initial temperatures in reducing the volumetric efficiency of air compressors was explained in the January and February issues of this journal, and earlier references—in the August, 1925, issue—explained, and showed by diagram, that, during compression, the work done in producing heat increases as the initial temperature of the air increases. Thus, the saving effected by collecting the water and re-circulating it through the jackets may give rise to a greater total loss than that which would be sustained by using a continuous supply of cold water and allowing it to run to waste.

Obviously, if the same water has to be re-circulated through the jackets, some means must be adopted for dissipating the heat in the water, after it leaves the jackets, so that it is brought back as near as possible to its original temperature. Special water cooling plants are manufactured to meet such cases, but the expense involved usually is more than is felt to be justified for comparatively small plants unless in very special circumstances. More often the means adopted merely fulfil the need to furnish a supply of water for circulating purposes, and have but little effect in reducing the temperature.

The most simple arrangement of this kind used for storage purposes is a vertical circular tank, which is mounted on the floor, near to the compressor, and from which the water is drawn, circulated through the compressor, and delivered back into the tank in a practically unbroken stream, by means of a small force pump driven from the compressor. The water in the tank is a column probably 6 ft. deep by 3 ft. diameter, which formation provides practically no facilities for radiation, even if the surrounding temperature would permit of this taking place, with the result that the temperature of the water continues to increase the longer the compressor is running, and, if not run off or a fresh supply of cold water added, would soon become quite useless so far as cooling the air being compressed is concerned. Exposing a tank of this kind to the outside atmosphere makes for but little improvement, but radiation can be assisted if the water returned to the tank is broken up by means of a perforated pipe fitted inside the top of the tank.

A better cooling effect can be secured by using a series of vertical circular storage tanks, so arranged that the bottom of one tank is connected, by means of a pipe, to a point near to the top of the next tank, and that the water from the jackets is delivered into the first tank while the pump suction is connected to the last tank. An arrangement of this kind ensures that the water will flow from one tank to another, and that it will be brought into intimate contact with radiating surfaces when passing through the connecting pipes. It is preferable that the tanks be placed in the open air, and with this system also, a perforated pipe in the first tank only, will further assist radiation of heat to the surrounding atmosphere. Even this arrangement, however, cannot maintain a constant low temperature of the water entering the jackets for any length of time, and some of the heated water has to be run off and cold water added at fairly frequent intervals, in order to prevent the temperature rising too high.

A tank placed some distance above the compressor, and from which the water is circulated through the compressor by means of the pressure due to the weight of the head of water in the tank and in the pipe connecting the tank to the jackets, is a method which has greater possibilities than either of those described above. With this method the pump is used to return the water to the tank, the delivery from the jackets being led into a sump, from which it is drawn off by the pump. The tank can be of a shape which is better suited for radiation, and often of much greater storage capacity. A special erection is sometimes built to carry the tank, but more often the tank can be accommodated on the roof. In whatever position it is placed, the tank should be exposed to the atmosphere, and when there is a danger of the water being polluted with foreign matter a covering should be placed above the tank or a sieve provided on the water outlet connection from the tank. The tank should be as shallow as possible, and if it is divided into sections so that the inflow has to rise and overflow each section before flowing through the outlet connection, the amount of radiation will be increased. This system can be further improved by fitting perforated pipes across the tank so that the water rises in a fine spray before settling in the tank, but when the perforated pipes are used the sectional divisions may be dispensed with. It is further possible to build a simple arrangement of cooling tower above the tank so that the water is made to flow slowly, and in thin streams, over layers of flat wooden boards before dropping into the tank.

Good results can be obtained with the overhead tank system, but from the point of view of the efficiency of the compressor it is advisable to make use of a continuous supply of cold water for jacket circulation whenever this can be obtained.

Evaporation.

The loss by evaporation frequently is considerable whenever the tank system is practised. This loss has to be made good in order to maintain the correct water level. A ball or float valve, connected to the main water supply, will maintain the correct water level automatically but where a fitting of this nature would complicate the basis of the charges for the water supply other arrangements have to be made for " make up " at intervals. When the tank or tanks are on the ground level this presents little difficulty, as the tanks can readily be inspected and fresh water added when required. Inspection is not so convenient with the overhead or roof tank, and, consequently, the automatic float valve cannot be dispensed with so readily. Where, however, the position of the tank permits the use of an indicator—connected to a float in the tank—to readily show the water level in the tank, other means can be adopted whereby fresh water can be added to the tank whenever this is shown to be required. The most simple way of doing this is by means of a small hand pump, from which a pipe is led directly to the tank.

Sight Flow.

It is always advisable to have the flow of water to or from the jackets within easy view of the attendant, sight glasses or overflow cups being used for this purpose.

Quantity of water required for the Water Jackets of Air Compressors.

Considerable doubt exists with regard to the quantity of water required for air compressors. Obviously, the quantity required will vary with the temperature of the water supply, and the air pressure also may be a factor in its determination; but even when these factors are known, other factors make it difficult to determine, by theoretical methods, the quantity of water required. The fact that the metal surrounding the cylinder becomes quite hot soon after the compressor is started, and that the air drawn into the cylinder abstracts heat from the metal before compression commences, and also during a portion of the stroke, means that the amount of heat given up to the water is greater than the reduction effected in the total heat produced during the compression of the air in the cylinder. Thus, the problem does not resolve itself into crediting the air with having lost the equivalent of the amount of heat which the water has gained. The importance of water circulation in an air compressor is to limit the mean temperature, so that if the temperature of the water supply is higher than normal, the rise in temperature must be kept down by circulating a greater quantity. Most makers have knowledge of the quantity required for their respective sizes and types, and if advised of the temperature of the water supply they will, in turn, advise as to the quantity per hour that should be circulated through the jackets.

As a rule the minimum quantity recommended, when the temperature of the water supply is not over 60° F., is *one gallon per hour for every cubic foot of free air delivered per minute.* When tank circulation is used, the possibility of higher initial water temperatures, with consequent higher rate of circulation, has to be provided for. In such cases the storage capacity of the tanks should be equal to 4 to 5 gallons of water for every cubic foot of free air delivered per minute. This capacity allows an ample margin for rapid circulation and ensures relatively slow movement of the water in the tanks.

Conditions in Hot Climates.

Since the average temperature of water is related to the climatic conditions, it cannot be expected that the cooling effect which it is possible to obtain in this country can be obtained in other countries where the atmospheric temperature is much higher. Thus, by reason of the diminished cooling effect of the water and the higher atmospheric temperature, the temperature attained in the cylinder of a compressor operating in a hot climate is much higher than that which, ordinarily, would correspond to the same working pressure in this country. The cooling problem, therefore, for hot climatic conditions, requires particular attention, and should be considered in relation to (1) the arrangements proposed for supplying the cooling water, (2) the probable highest temperature of the water and of the atmosphere, and (3) the working pressure. With the knowledge of these factors the makers of the compressor will be able to advise as to the most suitable type of machine and the quantity of water which should be circulated per hour.

On account of the higher cylinder temperatures attained and on the limited cooling obtainable with single-stage machines, it is customary, in hot climates, to use two-stage machines for lower pressures than those for which it is considered advisable to use this type of machine in this country. With the two-stage machine the cooling effect of the water can be utilised to a greater extent and with the pressure ratio, and heat produced during compression, divided over two cylinders, with intercooling between the cylinders, the cylinder temperatures can be kept sufficiently low to secure satisfactory lubrication.

When the tank system of circulation is used in hot climates every advantage should be taken of shade, and the tank should not be exposed to the direct rays of the sun.

Facilities for cleaning Water Jackets.

Cleaning doors should be provided on the water jackets of all air compressors, so that the jackets may readily be inspected and deposit cleaned out. With tank circulation mud frequently is deposited in corners and fillets, and has to be cleared away at regular intervals. Scale also is liable to be deposited inside the jackets, especially if the water in the jackets is heated to a high temperature; but even when cold water is used, and when the temperature increment is reasonably low, scale may still be deposited, because the particles of water which make actual contact with the metal of the cylinder walls and covers are heated to a temperature much above that of the body of the water, and which usually is high enough to cause the formation of scale. When scale is allowed to form inside the jackets it tends to insulate the metal from the cooling water so that the metal takes up a higher mean temperature and the transfer of heat is thereby considerably reduced.

A drain tap at the lowest point of the jackets will assist the cleaning operations, as, with this open, water can be played on to the jackets and into fillets and corners, and the deposit thus washed out. A long pointed nozzle attached to a hose pipe is useful to get at corners and fillets which otherwise might be inaccessible.

(*To be continued.*)

RELATIVE VALUES OF CARBON MONOXIDE AND HYDROGEN AS CONSTITUENTS OF PRODUCER GAS.

Continued from page 231.

Values Used as Basis of Calculations.

Heats of Combustion of Gases.

Gas.	Formula.	Molecular weight.	* Kg.-cal. per gram. mol.
Carbon monoxide	CO	28.00	68.0
Ethylene	C_2H_4	28.032	312.2
Hydrogen ..	H_2	2.016	57.8
Methane	CH_4	16.032	190.8

* At 60° F. and 29.92 inches of mercury pressure.

Mean specific heats of gases at constant pressure, from 0° C. to t° C., in kg.-cal. per gram. mol. per deg. Centigrade.†

$CO_2 = 8.8 + 0.0033t — 0.000,000,95t_3 + 0.000,000,0001t^3$

$O_2, N_2, CO, H_2 = 6.9 + 0.00045t$

$H_2O = 8.065 + 0.0005t + 0.000,000,000,2t^3$

$CH_4 = 7.7 + 0.008t$

$C_2H_4 = 9.4 + 0.011t.$

† Fier's values.

Mean specific heat × t = Thermal capacity per gram. mol.

Volumetric composition of air = 20.91 per cent O_2
79.09 per cent H_2.

Note : This paper is a revision of an earlier paper, " Relative value of carbon monoxide and hydrogen as constituents of producer gas for zinc distillation furnaces " (William E. Rice, Zn., vol. 6, No. 5, May, 1925.)

BOOKS AND CATALOGUES.

Journal of the British Society of Master Glass-Painters. No. 4; April, 1926. Published by the Society at 6, Queen Square, London, W.C.1. 10s. 6d.

The previous numbers of this Journal have already been mentioned in our columns, and the present number gives us no reason to withdraw the praise given to its predecessors; in fact, it would seem to be the best so far published. The articles are written by recognized authorities on the subject, and are moreover interesting even to those not closely connected with the craft, whilst the illustrations are excellent.

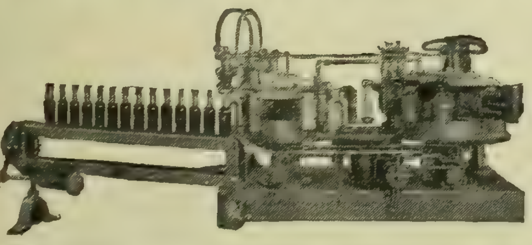
Lubrication. No. 1, Vol. xii., published by The Texas Oil Co., Ltd., Imperial House, Kingsway, London, W.C.2., contains much useful technical and practical advice on the proper lubrication of pneumatic machinery. In far too many instances one finds this type of equipment is neglected, and the adoption of some of the hints given in this booklet will undoubtedly lead to better and more efficient operation, with less cost for maintenance.

Chemical Plant. The British Chemical Plant Manufacturers Association, 166, Piccadilly, London, W.1., have issued an Official Directory of members, with classified lists of their manufactures. The book should be of material assistance to those requiring equipment of this nature. Furthermore, it is stated that the Association has secured the co-operation of all British plant manufacturers, irrespective of their membership of the association, and in cases where intending purchasers have difficulty in obtaining a particular article, will give every assistance in putting them into communication with possible suppliers.

Commercial Motors Operating Costs.

These tables issued by *The Commercial Motor*, 7-15, Roseberry Avenue, London, E.C.1, are in their eighteenth year of publication and form a valuable guide to all in charge of motor vehicles as to the costs of operation of the various types of comercial vehicles. Their use will enable a check to be kept on costs and undoubtedly will assist materially in securing economy in operation.

AUTOMATIC



May be Worked on Floor Level—No Pit Needed

NARROW NECK AND WIDE MOUTH
BOTTLE BLOWING MACHINE
No Transfer Boy. No Take-Out Boy.
STRICTLY AUTOMATIC
When Operated with Mechanical Feeding Device.
Can be Worked by Hand Gatherers. Speed 10 to 32 Bottles per minute, ranging in size from ¼ oz. to Gallon
LYNCH GLASS MACHINERY COMPANY,
ANDERSON, INDIANA, U.S.A.
Cable Address—"LYNCHNOBOY" ANDERSON
Codes—A.B.C. 5th EDITION, BENTLEY'S, WESTERN UNION

THE OPTICAL CONVENTION.

The Third British Optical Convention and Exhibition was held at the Imperial College of Science, South Kensington, London, from April 12—17. The last one was held in 1912, and it was extremely interesting to note the advances that had been made in instruments, both as regards mechanical and optical construction, since that time. In many instances the reason may possibly be traced to the requirements of the Services during the War.

Over 90 papers were listed for discussion, whilst numerous lectures were given during the course of the Convention. In addition, numerous very ingenious and in many instances, mystifying, entertainments were arranged.

Amongst the papers of interest to our readers was one by W. H. S. Chance, M.A., and W. M. Hampton, B.Sc., dealing with "Some recent developments in the art of production of glass for optical purposes." It consisted of a brief account of the work done by Messrs. Chance Brothers, Ltd., and pointed out that the firm, which was founded in Smethwick by Robert Lucas Chance in 1824 had at first made chiefly window glass, but engaged G. Bontemps and taken up the manufacture of optical glass in 1848, and were the only British firm in this latter field till 1914, when they listed 26 types of optical glass. The War first called only for flints and crowns; in 1917 light and dense barium crowns and an extra light flint were wanted for the photographic lenses of aircraft; in 1918 the firm reached its maximum output of 235,000 lb., which was equal to more than four times the world's pre-war demand for optical glass; at present the production of 112 varieties was on a greatly reduced scale. Dense barium crowns are probably the most difficult optical glasses to make, being extremely corrosive at high temperatures, and giving off a large amount of gas in fusion, one constituent being also relatively volatile. A special type of pot was developed to get over the first difficulty, the second being overcome by adopting special methods of "founding." A new type furnace was developed (oil-fired) in which the temperature can be controlled within plus or minus 5° C. at temperatures between 1,200° C. and 1,450° C. This has been in operation over three years, and has proved very successful. The chart of a recording pyrometer is previously marked with a line showing the temperature required to be held at any specific time, and the "teaser" has to follow this. In this way it is possible to repeat the heat treatment of a melt almost exactly to a previous melt.

Coloured glasses may be divided into two classes: those that depend on a coloured silicate being present, and those depending for their colour upon the uniform dispersion of particles of a constant size. These latter are the most difficult to produce, depending upon many varying conditions.

Many other special glasses, such as those used for railway signals, "Vita-glass," which is transparent to ultra-violet light, "Calorex," which absorbs the heat rays and yet transmits light, etc., etc., were described and mentioned. As a point of interest, Mr. Chance mentioned that they had recently received an order for optical glass from Germany, the first case of this kind for over forty years.

BUILDING TRADES EXHIBITION.

The fourteenth Building Trades' Exhibition was held at Olympia, London, from April 14th—28th, and from the variety of exhibits and quality of the equipment and materials shown, should rank as one of the best ever held. We also understand from numerous exhibitors that from a business point of view the show has also been a success.

In view of the important part which glass plays in modern building construction, whether for factories and industrial purposes or for residential or business premises, we were extremely surprised to find that no manufacturer or agent had considered it worth while having a stand at this Exhibition on which to show the many varieties and qualities that are now available.

On the other hand, the shop and window-fittings makers had several excellent exhibits. Amongst the stands worthy of especial attention was that of the London Sand Blast Decorative Glass Works, Ltd., Burdett Road, London, E.3. Here, examples of almost every kind of glass decoration were to be found, from a simple paper-weight to elaborately embossed windows, and coloured facias.

On the Stand of the Brilliant Sign Co. (1907), Ltd., of Shepherd's Bush, W.12, were specimens of the many types of signs made by the company which depend for their effectiveness upon the use of glass, either plain, decorated, or coloured.

Messrs. J. A. King & Co., Ltd., 181, Queen Victoria Street, London, E.C., were showing their "Ferroglass" construction for pavement and floor lights.

Don't Cool Your Moulds

with air from your main compressor—but use a Sturtevant Fan. It is more economical and gives ample volume for a small expenditure of power.

Write for our free catalogues, G.L. 1019 and G.L. 1241.

STURTEVANT ENGINEERING Co. LTD.
149 QUEEN VICTORIA ST. LONDON E.C.4

NATIONAL PHYSICAL LABORATORY.*

Since the dissolution of the Glass Research Association the work on glass carried out at the Laboratory has been restricted to a continuation of the measurement of viscosities at high temperatures, with the object of throwing further light on the fundamental constitution of glass.

The method employed, i.e., determining the amount of glass which adheres to a fine platinum wire immersed in the molten glass and withdrawn at a known constant velocity, has been further developed and now furnishes satisfactory results. As the glass is in contact, only with platinum, it has been found possible to repeat determinations a large number of times on the same glass, which can be subjected to any desired heat treatment without risk of contamination from refractory containers.

The results so far obtained would show that there is no appreciable variation of viscosity as a result either of time of heating, or of repeated cooling to room temperature, provided that the glass has first been rendered homogeneous by stirring during the first melting. This result has been confirmed in various ways, by subjecting the glass to different kinds of treatment, and suggests that the ideas indicated in the 1924 Report, concerning the possibility of gradual changes in glass, are in reality without foundation.

Should further work on other glasses fully confirm these results, they will be of great theoretical and practical importance. It would appear that homogeneous glass at high temperatures is a definite material, having properties dependent only on chemical composition, consequently, it should be possible to compare viscosity measurements made by different methods without reservation concerning the state of the glass, provided that care is taken to secure mechanical homogeneity in the first place. From the practical point of view it would further seem that various obscure but frequently occurring phenomena cannot be explained by assuming that the properties of the glass depend upon its past history. The present results suggest that investigation of the degree of hetrogeneity of commercial glass is of much greater practical importance than has hitherto been supposed, and that the effects of small changes of chemical composition may be much more marked than might be anticipated.

The apparatus and method have now been established, with a definite and satisfactory technique, in such a way that further measurements can be made with comparative ease and rapidity, and it is proposed to extend them to a variety of glasses, both commercial and specially prepared for the purpose.

With regard to the production for optical glass purposes of special pots of high resistance to solution by glass, as mentioned in previous Reports, larger examples have now been made successfully of the "Mullite" mixture, but an opportunity for testing them has not yet occurred.

[*The National Physical Laboratory Report for the year 1925. H.M. Stationery Office.]

SILLIMANITE

a neutral refractory material having a definite fusing temperature above 3270°F (1800°C).

The December issue of GLASS reported the following expert opinions expressed in papers or discussion at the Leeds Meeting of the SOCIETY OF GLASS TECHNOLOGY:—

Mr. H. H. Houldsworth (of the Fuel Department, Leeds University).

"Experiments made on commercial sillimanite bricks showed that they exhibit very little permanent change in dimensions on heating, their refractoriness is high, and they offer great resistance to attack by soda-lime-silica glass."

Mr. F. G. Clark (of Messrs. Beatson, Clark & Co., Ltd., Sheffield).

"I can testify to the particular resistance to attack of a mixture of about 66⅔ per cent. sillimanite, from experimental data obtained at my works."

Professor W. E. S. Turner (of the Department of Glass Technology, Sheffield University).

"Glass manufacturers seemed to be more keenly interested in the resistance offered to corrosion by glass, by a refractory material, than its ability to withstand unusually high temperatures."

Mr. W. J. Rees (of the Refractories Department, Sheffield University).

"Sillimanite mixtures containing not less than 60% sillimanite were already justifying themselves for purposes where a highly refractory, resistant material was necessary."

P.B. Sillimanite is now available in the raw state, crushed and graded, and in the form of Bricks, Blocks, Shapes, etc.

The P.B. SILLIMANITE
COMPANY, LIMITED,

Sole Agents: PAWLE AND BRELICK.

791, SALISBURY HOUSE,
LONDON WALL, LONDON, E.C.2.

Telephone Number - London Wall 4825.

Budget and "Safeguarding" of Glass Industry.

(BY OUR CITY CORRESPONDENT.)

The attention which has been focussed in these columns from time to time upon the future of the Safeguarding of Industries programme is justified by what has transpired during April.

In the first place the Board of Trade Committee which has been sitting in private to review the progress of the Key Industries has issued its report, which is an important White Paper of 48 pages. The members of the Committee were: Sir Burton Chadwick, M.P. (Chairman), Sir Arthur Colefax, K.B.E., K.C., Sir Richard T. Glazebrook, K.C.B., F.R.S., and Professor Sir William J. Pope, K.B.E., F.R.S., and with them were associated Mr. Percy Ashley, C.B., the Principal Assistant Secretary in charge of the Industries and Manufactures Department of the Board of Trade, and Mr. H. T. Tizard, Acting-Secretary of the Department of Scientific and Industrial Research; also one of the Commissioners of Customs. The detailed findings of the Committee in so far as they relate to the Glass Industry are of such interest that it may be well to set them out in full :—

Optical glass and optical elements, whether finished or not, microscopes, field and opera glasses, theodolites, sextants, spectroscopes and other optical instruments.

(a) *Optical glass.*

11. Optical glass of a wide range of types is of vital importance for the manufacture of the innumerable varieties of optical instruments required by the Fighting Services, and it is indispensable in the manufacture of a very large variety of optical instruments which are required for medical, physical, chemical, astronomical and other research, for the regulation of industrial processes, for nautical and aerial navigation, surveying purposes and for general laboratory and educational requirements.

12. Prior to the war the optical glass required by the manufacturers of optical instruments in this country was imported to the extent of approximately 90 per cent. from Germany and France. The remainder was the output of the one British maker, who manufactured only 26 varieties of glass, some of which, however, were at least equal in their essential features to the corresponding varieties made abroad. In the year 1915, and also at a subsequent period, the works were considerably enlarged for war production, and during the years 1916-1917 an additional factory was built by a second firm to supplement the war requirements of the Fighting Services and of our Allies. At a late period in the war a third firm also commenced to manufacture optical glass for use in its own output of optical munitions.

13. The large stocks of optical glass accumulated during hostilities both by makers and users were a serious bar to progress after the war, and as these were in many cases quite unsuitable for peace requirements very heavy financial losses resulted to the manufacturers. Despite these losses, however, every endeavour has been made, by further experiment and research, to improve the quality and range of manufacture, and two of the three firms now making optical glass offer respectively 95 and 80 varieties of glass. Evidence from consumers indicates the high standard of quality of the present production, a standard higher than that of pre-war days and unsurpassed in respect of many of the varieties by any other makers in the world.

14. Notwithstanding the increasing range and quality of the output of the British optical glass industry, sales at home are now but little in excess of those in 1921, and exports have fallen to almost negligible dimensions.

15. Accumulated stocks of optical glass and instruments at the time of the armistice, subsequent trade depression and scarcity of Service orders, and the entry of optical instruments from the continent where depreciated exchanges and cheaper labour made production costs in sterling very low, have been responsible for lack of growth in home orders for optical glass. The causes which favoured the entry of optical instruments, together with the tariffs imposed by foreign countries, combined to reduce orders for abroad. Every effort to meet competition has been made by way of improved methods of manufacture and quality of production, and prices have perforce been reduced to a level which has resulted in heavy losses. For some types of optical glass the prices during 1925 were approximately 50 per cent. under those of 1921, and still further reductions have been made during the current year in respect of certain kinds, bringing the prices down to figures less than 50 per cent. in excess of the pre-war level.

(b) *Optical elements and optical instruments.*

16. The term "optical elements" refers to such articles as lenses, reflectors and prisms made of optical glass or mineral substances. Various combinations of these elements, when assembled in suitable mounts and furnished with the necessary carrying, adjusting and other devices peculiar to each case, constitute the complete optical instrument. As with optical glass, so in the case of optical elements and instruments, the pre-war British industry, though small, was efficient, and in respect of some articles, such as range-finders, it occupied the premier world position. British photographic lenses held a high place in comparison with those of the best German makers, the best astronomical telescopes were unsurpassed by the corresponding foreign makes, and in the manufacture of special instruments required for particular scientific researches there existed a British firm far ahead of any foreign competitor. Between the best binoculars of British and foreign make there was little to choose, although here the adavantage was on the side of the foreign article. In respect of microscopes the British position was not so strong, although even here the best British microscope objectives were only surpassed in quality in some of the highest powers. The best foreign microscope elements were, however, of more uniform quality than were those of home manufacture. The weakness of the pre-war British industry lay primarily, therefore, not in the quality of its output but in its small scale of production of each class of optical element and instrument.

17. The German industry was in pre-war days ahead of that in this country largely owing to an assured market for its products consequent on the existence of a large standing army, and also upon the much wider degree of application of science to industry in Germany. Mass production methods were in operation and the resulting lower costs gave that country the advantage in export markets. The German home market is still very much larger than the home market in this country, with the consequence that overhead charges in manufacture are reduced, and cheaper methods of production can be employed than are available to our manufacturers whilst their market is small. The German makers can thereby undersell British instruments both in foreign markets and also, at least apart from the duty, in the British market as well. This advantage promises to be greater in the future owing to a recent agreement between the leading German optical firms aiming at reducing costs of production at practically all stages of manufacture from the raw material to the finished optical instrument.

18. In the French industry, on the other hand, instrument parts were made in the homes of the workers and assembled at a central factory, and this method is still in large measure employed.

19. Mass production became inevitable in the British industry during the war. The reduced market for optical instruments of recent years has, however, militated against the application of such methods for peace requirements, and the financial position of the industry makes further extension of mass methods of treatment and production difficult to initiate.

20. In the post-war years every reasonable effort appears to have been made by the optical instrument industry to reduce costs of production to a level at which progress might be possible, or at least its position be maintained. Plant, machinery and tools have been designed to reduce labour costs and improve the quality of the output. Nevertheless, as in the case of the

optical glass industry very heavy losses have been experienced and three of the firms out of the total of approximately twenty comprising the industry have gone into liquidation. Large stocks of instruments produced for war purposes, which are still being retailed, decreased orders from the Fighting Services, depreciated exchanges and low wages on the continent leading to large imports of cheap foreign instruments, and foreign tariffs against British exporters have combined to handicap the industry very severely.

21. In an endeavour to meet foreign competition prices have been reduced very considerably since the Safeguarding of Industries Act, 1921, came into force. Prices of one of the foremost firms in the industry which in the year 1921 were 100 per cent. above the pre-war level were reduced by 1923 to from 50 to 60 per cent. above the pre-war figure, and at present are from 30 to 60 per cent. above that level, the lower limit referring more particularly to the various types of lenses. The present degree of depreciation of the French franc has resulted in a reduction of import values to little more than one-half of the corresponding pre-war figures, and although to-day the mark is relatively stable, prices of the better known German optical instruments are still somewhat below the pre-war values. In addition large importations of French and German optical instruments by lesser known makers are arriving at nominal prices with which it is impossible to compete. It will be evident from these figures that, in respect of many elements and instruments, the present rate of duty gives inadequate protection in the home market. The degree of advantage which continental manufacturers have in foreign markets is also apparent.

22. The decrease in labour employed throughout the optical glass and instrument industries is very material compared with the pre-war volume of employment, and the present number of operatives employed, approximately 1,200, is estimated as being about 60 per cent. of those employed in 1913. This compares with the 78 per cent. of the pre-war numbers who were employed in 1921. The decrease is doubtless due in a small measure to the installation of labour-saving plant, but mainly it reflects the depressed state of the industries under consideration. The number of highly skilled operatives in the industry is understood to be already quite inadequate to enable that rapid expansion in output to take place which a serious national emergency would entail, and the number is still decreasing. The period required in the optical industry in which to train men for the exceedingly exact work in question is so very long that expansion of output is very much slower than in other industries.

23. Under the adverse conditions described, continued research is only possible in an industry of considerable inherent vitality, and the advances which have been made during the post-war years appear to us to prove conclusively that the effect of the safeguarding tariff has been in no way detrimental to progress. It has on the contrary been at least helpful in placing the British optical industry ahead of all competitors as regards the quality of many of its productions, although not unfortunately in respect of the price at which these can, in general, be marketed.

24. Considerable sums of money have been expended in the improvement of photographic lenses and cameras, and lenses of extra large aperture, many times as rapid as any previously known, have been designed. New apochromatic lenses for process and three-colour work, special types of lenses for sports and natural history photography and telephotography, lenses for taking and projecting cinematograph photographs, lenses for aerial photography, and many other new types have been produced, and the quality and range of lenses made by the British industry for all branches of photography appear to be superior to the best offered by foreign firms. Such high class lenses are, however, used only by the few, and by far the larger number of lenses sold in this country are of the cheaper and poorer quality, such as are made under conditions of cheap labour and depreciated currency. For this reason, whilst British manufacturers have installed the most modern labour-saving machinery, and would under equal conditions of wages and with normal exchanges be able to hold their own, heavy losses have resulted.

25. So far as spectacle lenses are concerned the large home market available would appear to offer the requisite condition for satisfactory development. The market in these articles, however, was formerly almost entirely in German, French and American hands, less than 10 per cent. of the home consumption being made here, and every effort has recently been made to stop the growth of and cripple this section of the British industry. British costs of production are in excess of those of foreign competitors, very considerably higher indeed than those in France. Low labour costs and the depreciated exchange in that country make competition with French products extremely difficult. The market obtained by the British manufacturer of spectacle lenses both at home and abroad has been gained entirely on the quality of his output, and whilst exports appear to have been maintained it is manifest that any great extension is improbable unless the British manufacturer is placed in a position to compete with foreign makers in price as well.

26. With regard to microscopes, new apochromatic objectives superior to any made abroad have been put on the market by British makers and are found to be essential for the most exacting type of microscopic work. Accuracy of focussing and rigidity have been secured on British microscope stands to a degree unequalled elsewhere. The high order of efficiency of the industry is further illustrated by the fact that when Gye and Barnard, in the investigation of filter-passing bacteria, required microscopes of a character not hitherto made in any country in the world for the further prosecution of their research, their demands were, within a comparatively brief time, met by a British maker.

27. So far as binoculars are concerned, the slight pre-war advantage of the German manufacturer has been reversed, and in addition at least one field glass has been manufactured with a larger angle of field than any made elsewhere. Manufacturers appear to have made a real effort to meet modern requirements and foreign competition.

28. The market in surveying instruments was seriously disturbed by the large Government stocks sold at very low prices after the war. Nevertheless the standard instruments have been re-designed and a number of new surveying instruments have been evolved. One firm who have devoted considerable expense to devising a more accurate method of dividing, are now producing divided circles of remarkable accuracy.

29. With regard to the very varied types of optical instruments essential in researches in modern physics, British instruments are of very high reputation, and instruments for dealing with special branches of research have been ordered from all parts of the world including various German universities and even the German State testing laboratory. A special new type of apparatus has been evolved by one firm for testing lenses in a manner which promises to revolutionise this branch of the industry. A new refractometer for testing optical glass has also been devised which is ahead of anything produced outside this country.

30. The private research work done by the firms in the industry is supplemented by that done for the industry as a whole by the British Scientific Instrument Research Association, which is aided by Government grant, and many problems of considerable importance to the industry have thus been successfully solved. The result of the private and co-ordinated research which has been effected in the post-war years has served to place the products of the British optical industry on a very high plane, and the Admiralty, War Office and Air Ministry, who are the largest users of optical instruments in the country, are satisfied that British instruments are capable of meeting their most exacting demands.

31. From the survey which we have made we are satisfied that under comparable conditions of manufacturers as regards wages, hours of labour and other factors, and with normal exchanges, the British optical glass and instrument industries would be well able not only to maintain their position but to show that financial prosperity which their efficiency appears to us to merit.

32. In addition, however, to the causes already referred to which have militated against success, there are two others which have prevented the realisation of that measure of security which was contemplated by the Act of 1921.

33. Although optical instruments as a whole are liable to duty, the component parts of these instruments are not all dutiable. Consequently, by importation of such non-dutiable parts in separate consignments, and assembly of them in this country, payment of the duty may be evaded. We understand that this fact has been very detrimental to the interests of the British manufacturers, and we are of opinion that a provision should be inserted in any new legislation dealing with the subject to render liable to duty all component parts of instruments which are themselves dutiable. In view of the fact that parts of optical instruments are as a rule applicable only to the assembling of

such instruments or of other scientific instruments likewise liable to duty, we consider that little or no difficulty is likely to arise in the administration of such provision by H.M. Customs.

34. It has been represented to us that the imports of duty-free cameras from Canada since Part I of the Act of 1921 became operative have also been very harmful to the British optical instrument industry. The duties levied by the Act are not, as already pointed out, applicable in respect of imports which have been consigned from and manufactured within the British Empire. Section 8 (1) of the Finance Act, 1919, empowers the Board of Trade to issue regulations prescribing the proportion of the value of Empire goods which is to be the result of Empire labour in order to obtain the Imperial preference resulting from that Act. That proportion was fixed by the Board, by Order dated August 6th, 1919, as a minimum of 25 per cent. of the total value of the goods. By virtue of Section 1 (3) of the Safeguarding of Industries Act, 1921, goods which would be deemed to be manufactured within the British Empire for the purposes of Section (8) of the Finance Act, 1919, are deemed to be so manufactured for the purposes of the Act of 1921. If, therefore, 25 per cent. of the value of cameras imported from Canada is the result of Canadian labour, such goods enter this country free of duty.

35. The following figures of importations of cameras from the United States and from Canada during 1921 and in later years, suggest that the representations are well justified, and that advantage has been taken of the 25 per cent. basis to import through Canada, American goods upon which only the necessary minimum of Canadian labour has been expended to permit of duty-free entry.

Imports of Cameras into the United Kingdom from the United States and Canada.

Period	From U.S.A.	From Canada.
1921	Number	Number
1st Quarter	124,817	—
2nd Quarter	100,844	—
3rd Quarter	67,431	—
4th Quarter	7,269	2,103
Total 1921	300,361	2,103
1921	Number.	Number.
1922	5,107	240,754
1923	37,007	322,053
1924	44,180	358,690
1925	65,395	387,870

36. The remarkable decrease since 1921 in the importations of cameras from the United States and the equally striking increase in the imports from Canada, commencing as they do in the very quarter in which Part I of the Act of 1921 came into operation, appear to indicate that the avoidance of the safeguarding duty in the manner suggested has been of serious magnitude.

37. This might in the future be prevented we think, both in the case of cameras and other optical instruments, by raising the proportion of the value of the goods within the Schedule which is required to be the result of Empire labour from 25 to 75 per cent. This latter figure is operative in Australia for Empire preference purposes in the case of imports of optical instruments of the kinds which are made in that Dominion. Under a 75 per cent. basis it might still be possible when cameras or other optical instruments are fitted with the cheaper kinds of American lenses, for the lenses to escape payment of duty. We are informed that large numbers of American lenses are fitted to cameras imported from Canada, and that thereby the beneficial effect of the safeguarding duty on camera lenses is very seriously diminished. We accordingly recommend that in addition to raising the qualification for freedom from duty from 25 to 75 per cent., lenses should be treated as separate articles from the rest of the camera or other optical instrument for duty purposes.

38. We have carefully considered the question of the sufficiency of the present rate of duty, and having regard to the inadequate protection given by the present rate of duty in respect of many of the articles in question, we are of opinion that there is much to be said for an increase from 33⅓ per cent. to 50 per cent. This would increase the sales of the British products, and a decrease in costs of production and a reduction in price may reasonably be expected to follow the greater proportion of factory capacity thus utilised. At present, restricted demand renders overhead charges disproportionately high. Should the market available justify mass methods of production, costs would fall still further.

39. To sum up, we are satisfied as to the great importance of the optical glass and optical instrument industries, not only from the point of view of national defence, but also from that of the desirability of maintaining industries which are themselves of the highest scientific value, and which contribute to the efficiency of many other important industries of this country. Owing to causes beyond their control such as accumulation of war stocks, reduction in Service orders, the remarkable depreciation of continental currencies, low continental wage rates, and the loss of the export markets by high tariffs abroad and undercutting by continental competitors, the industries have failed to obtain the full benefit which had been originally contemplated by the present Act. The duty has in general prevented complete disaster to the industries, but it has not given them that financial stability which is necessary to enable them to embark on new methods of manufacture and new research to the full extent which is desirable. Nevertheless very substantial progress has been made both in range and quality of products. We are, therefore, of opinion that protection in these industries should be continued, and should, moreover, be strengthened in the four directions we have indicated, namely, by raising the rate of duty, by raising the proportion of the value of goods which is to be the result of Empire labour in the case of imports from within the Empire, by treating lenses contained in optical instruments as separate articles for duty purposes, and by including for duty all component parts of dutiable instruments.

Beakers, flasks, burettes, measuring cylinders, thermometers, tubing and other scientific glassware and lamp-blown ware, evaporating dishes, crucibles, combustion boats and other laboratory porcelain.

(a) *Scientific glassware and lamp-blown ware.*

40. Scientific glassware consists in general of furnace-blown ware and of lamp-blown ware. In the former class the glass tubing or other article to be manufactured is blown and otherwise fashioned by a highly skilled operative from molten glass taken direct from the furnace. The majority of the articles falling within the latter class are made from glass tubing, but all of them are the product of the labour of a skilled operator working at the bench with the aid of a blow-lamp. Many of the articles falling within both types are subsequently calibrated for volumetric purposes.

41. Scientific glassware, both furnace-made and lamp-blown, is used in the chemical, biological and other laboratories of educational and research institutions and industrial concerns, and prior to 1914 was in the main imported from Germany and Austria. High grade thermometer tubing and a small quantity of medium and higher grade lamp-blown ware were made here. Competition with the imported lower grade lamp-blown ware, largely the product of cottage industry, rendered its production in this country almost out of the question.

42. The outbreak of hostilities rendered large supplies immediately necessary for the medical services, explosive manufacture, analytical operations in steelworks and in researches undertaken for war purposes. Manufacturers of table and illuminating glassware commenced manufacture, and additional factories, of which two are still in operation, were erected for the production of scientific glassware.

43. Large importations of foreign glassware followed the removal of restrictions on importation at the end of the year 1919, and continued whilst the Safeguarding of Industries Bill, 1921, was passing through Parliament. In the case of the more common types, quantities estimated at two years' consumption were imported during the few months immediately prior to the commencement of the operation of Part I of the Act. The industry was thus faced with a very serious reduction in demand, furnaces had to be closed down, the cost of expensive idle plant had to be carried, and the firms concerned have only been able to continue manufacture with an annual loss. These difficulties, combined with the collapse of the mark, served to nullify any immediate benefit which might have been expected from the passing of the Act.

44. The production in quantity of hand-made ware required large numbers of highly skilled workers, such as have been available in Germany for generations owing to the virtual monopoly enjoyed by that country. In the United Kingdom men had to be specially trained for this type of ware. Further, as regards moulded glassware labour costs are a very high proportion of

the whole, and the lower wages and longer hours worked abroad prevented the duty imposed by the Act being an adequate protection.

45. The heavy ware portion of the furnace-blown section of the trade has suffered even more than the other sections and the largest British maker, whilst having available all the necessary moulds, has found it necessary to transfer most of the blowers to other work.

46. The light furnace-blown ware has also had considerable difficulty in meeting the very fierce competition from Germany and Czecho-Slovakia. The wages in sterling in these countries are much below those in the United Kingdom. In addition, owing to longer working hours, the fuel consumption and over head charges for a given output of glassware abroad are lower than in this country. In the case of Germany, moreover, a large home market is assured, and by manufacturing in excess of their home requirements the German manufacturers are enabled to reduce costs of production and sell in this country and elsewhere much below the prices at which British makers can profitably produce. British manufacturers have been able to make sales only by reducing prices to the utmost limit. In the case of heat resistance tubing, for example, sales show a small upward tendency, users having realised that it is better in the long run to buy the higher quality article, even if somewhat dearer, rather than the cheaper foreign one.

47. That section of the industry which manufactures lamp-blown ware has also had considerable difficulty in meeting competition from Germany in the types of ware more particularly which are the products of the Thuringian cottage industry, such as ampoules for medical work, test tubes, and tubes for clinical and other thermometers; nevertheless this section is just able to hold its own with the aid of the existing duty, and employers in most cases are now able to maintain their workers on full time.

48. In general it may be stated that the existing duty has enabled British maufacturers to maintain and even increase their output. To do this it has been necessary for them to improve the efficiency of their methods of manufacture and the quality of their production. In some instances also new types of glass have been evolved.

49. Evidence made available to the Committee from large users of scientific glassware indicates that the British ware is of high quality and is unsurpassed by and indeed surpasses the best foreign makes. No difficulty is experienced in meeting the tests of the National Physical Laboratory for volumetric glassware.

50. As already indicated foreign competition has rendered considerable price reductions inevitable since the passing of the Act, and every effort has been made by British manufacturers to improve the efficiency of their operations so as to enable these reductions to be made with the minimum of financial loss. With regard, for example to general laboratory glassware of the light furnace type, prices in 1925 had fallen to about two-thirds of those ruling in 1921 and the price of laboratory glass tubing and test tubes had fallen to approximately half the 1921 figure. The rising cost of production in Germany has improved the market of late for the British manufacturers, and it appears that the price to British buyers of certain types of chemical glassware of good quality manufactured by the best German firms, when the duty and freight are added, is now very close to the price of the corresponding British product. When the margin in favour of the foreign manufacturer is small, orders are given to the British maker which would otherwise go abroad, as the high quality of the British article and the quick delivery possible more than outweigh a slightly higher price. If the duty were removed it appears to us that the price of the foreign article would be so much below that at which sales of British manufacture are possible, that the industry would be placed at a very grave disadvantage.

51. The industry is of the highest importance to this country both in times of peace and war, and we are of opinion that it is extremely undesirable that the United Kingdom should ever again be dependent upon foreign makers for articles of such wide and general application. The evidence available to us suggests that a further period of safeguarding should enable the industry to consolidate itself on a firmer basis than has been possible hitherto and ultimately enable it to stand alone.

This report was issued only a few days before the Budget speech, when the Chancellor created surprise by the announcement that not only would the Key Industries Duties be continued for a fixed term of 10 years, but that the increase of duty recommended in the case of optical glass and the other goods specified in the first paragraph of the Schedule of the 1921 Act would take effect as from May 1st, 1926. It is not my purpose to discuss here the merits of the Committee's findings, but to refer, rather, to the immediate commercial aspect of the Chancellor's announcement.

In the first place it should be made clear that the Customs have no power to insist upon the payment of the extra duty until such date as the Summer Finance Bill becomes law. This will probably be somewhere about the beginning of July. But this extra duty will eventually become chargeable on these goods where the Customs entries are passed or the goods delivered from bonded warehouse on or after May 1st, irrespective of the date of importation. A note will be taken of the names and addresses of the importers as indicated upon the Customs entries, or of the persons who take delivery of the goods. It may suit such persons to make a deposit of the required sum of money with them in anticipation of its subsequent attachment, but in any case they will become liable to pay duty in due course. This is a novel feature of the Budget proposals and is, of course, designed to prevent interim dumping.

I predict, however, that before the Finance Bill completes its committee stage in the House some concession will be intimated to meet cases of hardship which will obviously arise. The importer who at the time of the Budget announcement actually had goods in transit from foreign works in the normal and legitimate course of business is obviously entitled to some consideration, without any detriment to the Chancellor's main policy, i.e., to prevent evasion of duty by abnormal importations following his Budget speech. Instances have been brought to my notice where very heavy and serious financial loss will result if some relief is not accorded. The matter may be carried a step further in respect of short term outstanding contracts, but this I think is improbable, since the Finance Act of 1901 already provides that the importer can insist upon his customer paying the extra duty unless he is willing to forego delivery of the goods. In that case the importer may have some trouble with his foreign supplier, but this perhaps will not be taken into account by the Chancellor. The undeniable case for relief is that of the importer, who would either have to pay the extra duty out of his own pocket, or else ship the goods back to the foreign works at his own expense, paying the double freight.

Another point in the Committee's recommendations which will give rise to considerable controversy is the proposal made in paragraph 37 given above. It is true that the question of percentage of Empire labour is raised specifically, and only in the case of cameras and other optical instruments; but it is easy to see that if the Chancellor acts upon this recommendation in one instance it will create a precedent which is bound to affect the whole of our Customs practice where Empire goods are concerned.

As I am writing within a few hours of the Budget announcement, and as this particular issue has not yet been officially dealt with, I can only refer to it in passing, and suggest that the Government will probably go very cautiously in the matter until it has ascertained the view of other industries, which may be seriously affected by any decision that is made.

The Flint Glass Trade.

The agitation of the Flint Glass Trade for a safeguarding tariff was carried a stage further in April. A booklet was prepared containing reprints of the articles and some advertisements which appeared in February and March in the *Daily Telegraph* and in certain North of England newspapers. At the end of it a notice appeared advertising a Public Meeting to be held on Tuesday, April 20th, at the Caxton Hall, Westminster. At this meeting Mr. P. J. H. Hannon, M.P., presided, and about 60 people attended. The audience was composed mainly of members of the glass industry and a few distributors who were in sympathy. There were, however, a few persons at the meeting who were manifestly opposed to the tariff demands. Two at least admitted that they were not in the glass trade, but they claimed that they were entitled to be present at the meeting since it was convened as a public meeting. In this contention they were no doubt correct, since it is unwise to call a public meeting if you are not prepared for members of the public to attend. The result was some little disturbance and several interruptions. The agenda was as follows :—

1. The Chairman (Mr. P. J. H. Hannon, M.P.) opens the meeting.

2. Resolutions in the following terms to be proposed by Mr. Bradford (Financial Secretary of the National Flint Glassmakers' Society), and seconded by Mr. Williams Thomas, O.B.E. (Chairman of Messrs. Stevens & Williams, Ltd.), and supported by Mr. Walter Raine, M.P., and Mr. Douglas Percival Pelou, M.P.

> " Resolved, that this meeting of employers and workpeople engaged in the British flint glass industry desires to call the attention of the President of the Board of Trade to the following statement of the Prime Minister previous to the last General Election, namely :—
>
> " ' We are determined to safeguard the employment and standard of living of our people in every efficient industry in which they are imperilled by unfair competition.'
>
> " That, in the opinion of the meeting, the recent decision of the Board of Trade in refusing the application for safeguarding made by the flint glass industry is not in accordance with the Prime Minister's promise, and it respectfully urges that the application be re-opened and a deputation received by the President, so that the whole of the facts relating to the conditions which obtain in the trade may be placed before him."

3. The following gentlemen will also address the meeting, viz. : Sir Arthur Shirley Benn, K.B.E., Mr. Luke Thompson, M.P., Mr. W. H. Stuart (Chairman of Stuart & Sons, Ltd.), Mr. E. A. Hailwood (Managing Director of Ackroyd & Best, Ltd.), Mr. E. J. Purser (Chairman of James A. Jobling & Co., Ltd.), Mr. Stanley Bagley (Chairman of Bagley & Co., Ltd., the Crystal Glass Co.), Mr. Percy Brooks (Manager of Harrods, Ltd., Glass Department), and Mr. Weaver.

4. To nominate a deputation to consist of four employers and four workpeople to wait upon the Industrial Group of the House of Commons, at 6 p.m., on April 20th, 1926, at the House of Commons, to be introduced by Mr. J. Donaldson Harward, Secretary of the Flint Glass Manufacturers' Association.

5. To nominate a deputation to consist of six employers and six workpeople, accompanied by Mr. J. Donaldson Harward, to wait upon the President of the Board of Trade, on a date to be hereafter fixed, to lay before him the terms of the foregoing resolution.

6. To pass a vote of thanks to the Chairman, to be proposed by Mr. Herbert Webb (Chairman of T. Webb & Corbett, Ltd.), and seconded by Mr. R. H. Woods (Managing Director, John Walsh Walsh, Ltd.).

After discussion the resolution referred to above was carried with one or two dissentients, and the deputation then proceeded to the House of Commons, where Sir Arthur Shirley Benn presided over a meeting of the Parliamentary Industrial Group. The general case of the Flint Glass Industry, which has already been described in these columns, was urged once more upon the M.P.'s, and certain questions were asked. It was stated that in 1913 there were 19 firms in the industry employing 3,600 men, and that to-day there are 22 firms employing 4,400 men. The glassmakers, however, contended that the industry, if properly protected could employ three times that number. Mr. Bradford gave evidence that the membership of his particular Union had been steadily declining, and that to-day he had only 328 paying members on his books out of a total of 1,680. He said that 62 big furnaces had closed down in different parts of the country.

Major Salmon (the member for Harrow, who is well-known as a director of Messrs. J. Lyons & Co., Ltd.) asked a number of questions which appeared to indicate that he knew of cases where British firms had offered large orders which they were unable to execute. He also pointed out that having regard to the present difference in price between English and foreign glassware, even a 33⅓ per cent. tariff would fail to bridge the gulf.

I understand that a fresh memorandum is being prepared in Stourbridge for submission to the Industrial Group in the House, and that this may be made the basis for an interview between the members of that Group and Sir Philip Cunliffe-Lister. Manifestly the industry will find its contentions criticised by the Board of Trade, seeing that the Department has already on at least two occasions given a considered negative judgment. For this reason I do not find a great deal of expectation that the Board of Trade will change its mind and grant a Committee of Enquiry. On the other hand, political considerations may prevail, and the Government may decide to cut the knot by referring the matter to a Committee and placing the onus upon this tribunal. This, at least, would relieve the Board of Trade of any charge of having unfairly prevented the glass industry from getting its claims independently considered.

If the Committee is appointed there is no reason to believe that the opposition will be less well organised than it has been on similar previous occasions, and in several recent safeguarding enquiries of an important character the opposition has been successful contrary to general expectation.

March Trade Returns.

IMPORTS OF GLASS AND GLASSWARE.

		QUANTITIES.				VALUE.			
		Month ended March.		Three months ended March.		Month ended March.		Three months ended March.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod) ...	value	—	—	—	—	6,151	6,488	16,088	18,282
Glass Tubing and Rod for all purposes	cwts.	330	575	1,547	1,837	1.877	1,736	5.562	5.561
Illuminating Glassware	,,	8,402	10,265	31,504	37.458	21,317	28,054	86,421	106,943
Machinery Glassware	,,	—	4	29	19	—	44	416	218
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	45.344	53,725	129.967	146.742	122,800	154,351	353.773	406,569
Plate and Sheet Glass	,,	99.304	103,823	276.615	307,014	138,716	144,658	406,880	411,794
Optical Glass (other than worked Elements, *e.g.* Lenses)	,,	9	2	22	7	662	250	1,420	554
Bottles and Jars	gross	110.058	134,516	309.379	363.683	64,804	76,928	186,713	215,660
Glass and Glassware not elsewhere specified ...	cwts.	1,520	2,685	3.903	7.979	5,696	7,046	14,646	21,113
Total Value	£	—	—	—	—	362,023	419,555	1,071,919	1,186,694

EXPORTS OF GLASS AND GLASSWARE (BRITISH PRODUCTS).

		QUANTITIES.				VALUE.			
		Month ended March.		Three months ended March.		Month ended March.		Three months ended March.	
		1925	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod) ...	value	—	—	—	—	4,748	6,220	17,572	18,109
Tubing and Rod for all purposes...	cwts.	66	505	870	1,310	674	3,282	5,981	7,820
Illuminating Glassware	,,	496	626	1,411	1,482	4,503	5.317	14,005	12,940
Machinery Glassware	,,	358	189	1,084	660	2,594	1,399	7.357	4.821
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	2,583	2,640	7,732	6,858	22,657	25,779	67,347	67,276
Plate and Sheet	,,	57,699	78,761	196,593	248,926	112,147	138,226	397,293	441,247
Optical (other than worked Elements, *e.g.* Lenses)	,,	—	7	22	13	36	232	727	353
Bottles and Jars	gross	31,137	33,043	78,116	81,416	33.417	28,688	82,093	79.371
Manufactures, not elsewhere specified	cwts.	692	661	1,763	2,318	3,975	4,262	9,832	13.846
Total Value	£	—	—	—	—	184,751	213,405	602,207	645,783

EXPORTS OF GLASS AND GLASSWARE (FOREIGN AND COLONIAL MERCHANDISE).

		QUANTITIES.				VALUE.			
		Month ended March.		Three months ended March.		Month ended March.		Three months ended March.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod) ...	value	—	—	—	—	462	640	1,510	1,418
Glass Tubing and Rod for all purposes... ...	cwts.	3	4	5	7	29	37	54	85
Illuminating Glassware	,,	174	228	544	527	1,369	2,226	4,213	4,631
Machinery Glassware	,,	—	—	—	2	—	10	6	36
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	756	784	2,138	1,872	4,715	5.514	12,029	12,085
Plate and Sheet	,,	65	695	664	1,602	104	901	833	1,779
Optical Glass (other than worked Elements, *e.g.* Lenses)	,,	1	6	4	9	11	37	86	56
Bottles and Jars	gross	1,048	1,175	4,941	3,096	1,321	1,178	5.044	2,964
Glass and Glassware not elsewhere specified ...	cwts.	37	53	155	163	345	121	1,682	540
Total Value	£	—	—	—	—	8,356	10,664	26,357	22,594

United States Patents.

GRANTED MARCH 9, 1926.

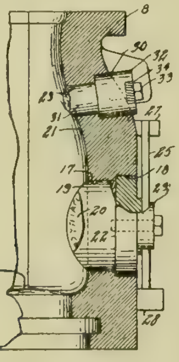
1,575,969.—**Apparatus for Fabricating Reinforced Glass.** William C. Bull, Brooklyn, N.Y. Filed June 26, 1924. Serial No. 722,519. 24 Claims. (Cl. 18—17.)

8. In an apparatus of the class described, a casing, a multiple press device arranged within said casing and including a plurality of superposed press units, means for setting said units to the desired spacing, a flexible diaphragm carried by each unit, and means for simultaneously applying pressure to each diaphragm.

1,576,114.—**Machine for Making Glass Containers.** Warren E. Glaspey, Bridgeton, N. J., assignor to Spring Stopper Company, New York, N. Y., a Corporation of Delaware. Filed October 22, 1923. Serial No. 670,041. 5 Claims. (Cl. 49—10.)

1. In a machine of the character set forth, the combination with a reciprocable press-plunger equipped with a pressing tool, of an independently movable cross head, a nut mounted thereon, an annular mandrel receiving said tool and having a threaded shank working through said nut and having a thread-equipped tip, gear mechanism mounted on said cross-head and adapted to rotate said mandrel, said gear mechanism being equipped with means for limiting the number of rotations, a clutch associated with said gear mechanism, a driving shaft having splined connection with said clutch, and reversing gear mechanism serving to actuate said shaft in either direction.

1,576,212.—**Mold Marker Mounting.** Frank O'Neill, Toledo, Ohio. Filed July 10, 1924. Serial No. 725,273. 7 Claims. (Cl. 49—70.)



1. A mold having a side wall with an aperture therethrough, a marker for the mold produced article insertable from exterior of the mold directly into said aperture into aperture closing position, and yieldable locking means angularly shiftable over the mold side wall adjacent the aperture for flexing in anchoring the marker in aperture closing position.

1,576,221.—**Glass-Working Machine.** Francis J. Rippl, Cleveland, Ohio, assignor to General Electric Company, a Corporation of New York. Filed October 18, 1919. Serial No. 331,660. 13 Claims. (Cl. 49—7.)

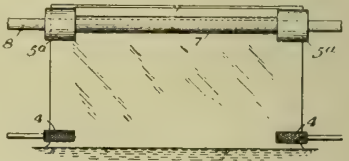
1. In a machine for shaping glass tubes, the combination of a carrier rotatable in a substantially vertical plane, a holder mounted thereon having a passage therethrough disposed so as to allow a glass tube to feed therethrough by gravity, and means for gripping said tube, means disposed in the path of travel of said holder whereby tubes may be fed to said holder, tube heating and shaping means disposed in the path of travel of said holder, and means automatially brought into operation for periodically opening said gripping means to discharge a tube and for subsequently causing said gripping means to close upon a fresh tube.

10. In a machine for flaring tubes, a carrier, a plurality of rotatable tube holders, means for simultaneously rotating said tube holders, means for heating the tubes and means for flaring said tubes while heated.

1,576,363.—**Composition for Preventing the Accumulation of Moisture in Droplets upon Glass or other Polished Surfaces.** Madeleine Ross, Montreal, Quebec, Canada. Filed December 22, 1924. Serial No. 757,578. 5 Claims. (Cl. 134—27.)

2. A process of producing a material for preventing the accumulation of moisture in droplets upon glass or other polished surface which consists in treating an aqueous solution of gelatine separately with concentrated nitric acid and concentrated chromic acid and mixing the resulting products.

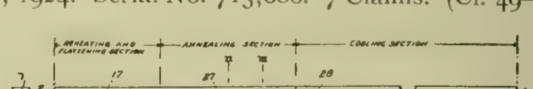
1,576,446.—**Drawing Glass Sheets.** William L. Monro, Pittsburgh, Pa., assignor to Window Glass Machine Company, Pittsburgh, Pa., a Corporation of New Jersey. Filed April 23, 1920. Serial No. 375,972. 7 Claims. (Cl. 49—17.)



3. Apparatus for drawing sheet glass, comprising a bath from which a sheet of glass is drawn, a pair of bending roll portions engaging the edge portions only of a drawn sheet, the bending roll portions being a substantial distance above the bath, and width maintaining means associated with each sheet edge adjacent the bath.

GRANTED MARCH 16, 1926.

1,576,516.—**Process and Apparatus for Annealing a Continuously-formed Glass Sheet.** Walter G. Koupal, Tarentum, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed May 13, 1924. Serial No. 713,086. 7 Claims. (Cl. 49—47.)



1. In combination in a leer for annealing a continuously formed ribbon or sheet of glass comprising a tunnel leer chamber, means for supporting the glass sheet above the floor of the chamber and carrying it through the chamber, and gas heating means located in the leer chamber along its side walls below the level of

the glass extending longitudinally thereof and directed inwardly so that a greater amount of heat from said means is applied to the side portions of the sheet than to the central portion.

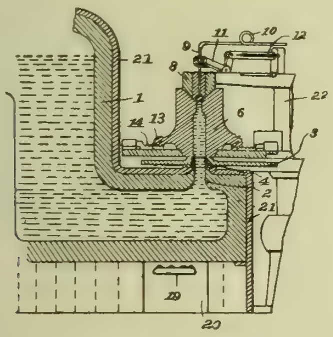
1,576,550.—**Refractory Cement Composition.** William F. Rochow, Pittsburgh, Pa., assignor to Harbison-Walker Refractories Company, Pittsburgh, Pa., a Corporation of Pennsylvania. Filed August 26, 1921. Serial No. 495,543. 1 Claim. (Cl. 106—9.)

A dry powdered refractory cement composition consisting of silica, fire clay, calcined silica, and from 5 to 20 per cent. of sodium silicate.

1,576,732.—**Arc-Resisting Material and Process of Making.** Otto H. Eschholz and Paul G. Gues, Wilkinsburg, Pa., assignors to Westinghouse Electric and Manufacturing Company, a Corporation of Pennsylvania. Filed July 30, 1920. Serial No. 400,233. 7 Claims. (Cl. 18—47.5.)

1. A refractory article comprising a refractory base including silica and a hydrous inorganic binder of sodium silicate, and having a thin glaze of anhydrous sodium silicate on the surface thereof.

1,576,733.—**Process of Making Glassware.** Enoch Ferngren, Washington, D. C. Filed January 20, 1920. Serial No. 352,725. 10 Claims. (Cl. 49—77.)



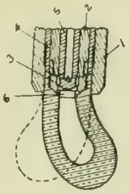
1 The process of obtaining mold charges from a supply of molten glass comprising causing glass to issue continuously from a discharge orifice in a stream of periodically increasing and decreasing velocity, shearing a mold charge from each portion discharged with increased velocity, and moving with the shear with the said charge during severance.

7,576,734.—**Cutting Apparatus.** Enoch T. Ferngren, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Filed June 12, 1922. Serial No. 567,518. 13 Claims. (Cl. 49—55.)

1. In glass severing apparatus, the combination of shears, means to move said shears horizontally for cutting, and means to tilt them during the cutting stroke in the same direction about a common horizontal axis perpendicular to their direction of cutting movement.

1,576,743.—**Glass-Forming Apparatus and Method of Forming Glass.** Orin A. Hanford, Columbus, Ohio, assignor to The Federal Glass Company, Columbus, Ohio, a Corporation of Ohio. Filed April 14, 1921. Serial No. 461,267. 15 Claims. (Cl. 49—20.)

15. Glass blowing apparatus comprising means for oscillating a blank at an angle from the vertical and about its own axis, the oscillation of said blank being such that the sides will be alternately stretched and compressed.



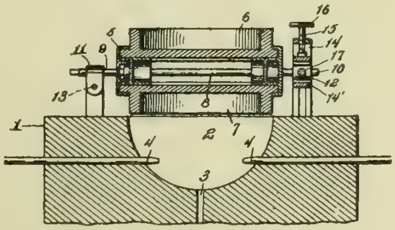
1,576,744.—**Apparatus for Blowing Glassware.** Orin A. Hanford, Columbus, Ohio, assignor to The Federal Glass Company, Columbus, Ohio, a Corporation of Ohio. Filed August 22, 1921. Serial No. 494,078. 10 Claims. (Cl. 49—18.)

1. Means for introducing fluid to glass blanks comprising a pipe leading to the blank retaining head, a normally closed valve in said pipe, a nozzle structure through which fluid is adapted to flow continuously, means for moving said nozzle intermittently into position to supply fluid to said pipe and means for opening said valve prior to or at the instant of positioning of said nozzle.

1,576,745.—**Apparatus for Blowing Glass.** Orin A. Hanford, Columbus, Ohio, assignor to The Federal Glass Company, Columbus, Ohio, a Corporation of Ohio. Filed Otober 17, 1921. Serial No. 508,128. 9 Claims. (Cl. 49—18.)

1. Apparatus for delivering air to the interior of a glass blank comprising a receptacle containing a moistening fluid, a wick member over which the air passes, said wick member having a portion immersed in said moistening fluid.

1,577,007.—**Method of and Means for Drawing Glass Cylinders.** William Westbury, Independence, Kans., assignor, by mesne assignments, to Harding Glass Company, Fort Smith, Ark., a Corporation of West Virginia. Filed May 12, 1922. Serial No. 560,434. 4 Claims. (Cl. 49—17.1.)



1. In a glass drawing apparatus, a glass drawing pot, a rotary support for the pot extending on a line diametrically of the pot in one direction and on which the pot is adapted to be tilted in a direction at right angles to such diametrical line, said support being fulcrumed at one end, and means operative upon the opposite end of the support for swinging said support on its fulcrum and tilting the pot in a plane coinciding with the said diametrical line and at right angles to the direction of tilting motion first mentioned.

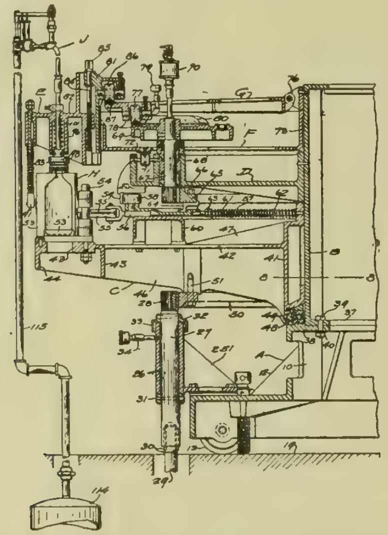
4. In the art of drawing glass cylinders from a charge of glass in a pot, the method of correcting defective draws due to the lateral displacement of the cylinder from the normal drawing zone, which consists

in tilting the pot, while drawing, on either one or both of two axes one lying in a plane diametrical of the pot and the other in a plane at right angle thereto.

1,577,008.—**Glass-Drawing Apparatus.** William Westbury, Independence, Kans., assignor, by mesne assignments, to Harding Glass Company, Fort Smith, Ark., a Corporation of West Virginia. Filed May 12, 1922. Serial No. 560,435. Renewed January 21, 1926. 6 Claims. (Cl. 49—53.)

1. A drawing pot structure comprising a frame carrying a fixed pot clamping member and a removable pot clamping member, said members having flange engaging lips, a pot having a flange adapted to be engaged by said lips, and means for securing the removable pot clamping member in clamping position.

1,577,131.—**Bottle Machine.** Richard La France, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Filed May 24, 1919. Serial No. 299,430. Renewed March 21, 1924. 7 Claims. (Cl. 49—18.)



5. In a bottle machine, the combination of divided molds, means to cause the molds to travel continuously in a closed path, automatic means for opening and closing said molds at definite points in their travel, a blowhead, automatic means for bringing said head into engagement with said molds and causing it to travel with the molds for short periods when said molds are closed, and means actuated in response to the movement of said head to firmly lock the molds in position by their engagement with said head.

GRANTED MARCH 23, 1926.

1,577,536.—**Apparatus for Severing Glass.** Alvah C. Parker and Carl W. Schreiber, Toledo, Ohio, assignors to The Libbey Glass Manufacturing Company, Toledo, Ohio, a Corporation of Ohio. Filed April 3, 1924. Serial No. 703,855. 14 Claims. (Cl. 49—2.)

1. Apparatus for severing glass articles having forms of rotation, comprising means to support such an article, means to move the support in a closed path, an annular burner, and means to move the burner into position about the proposed line of severance of an article in th support and move the burner with the support until the glass is melted along said line.

1,577,537.—**Apparatus for Burning Off Glass.** Alvah C. Parker, Toledo, Ohio, assignor to The Libbey Glass Manufacturing Company, a Corporation of Ohio. Filed April 7, 1924. Serial No. 704,579. 24 Claims. (Cl. 49—50.)

1. In an apparatus for severing glass, a melting-off burner, a holder adapted to hold a glass article with its point of desired severance exposed to a flame from the burner, and automatic means operable upon the completion of a severance to increase the distance between the burner and holder and means to stop said increase at a fraction of an inch.

1,577,538.—**Apparatus for Burning Off Glassware.** Alvah C. Parker, Toledo, Ohio, assignor to The Libbey Glass Manufacturing Company, a Corporation of Ohio. Filed November 1, 1924. Serial No. 747,307. 32 Claims. (Cl. 49—50.)

1. In apparatus for burning-off glassware, a burner, a vertically reciprocable article carrier beneath the burner, and automatic means whereby an article is held in position on the carrier when the carrier is raised and is released when the carrier is lowered.

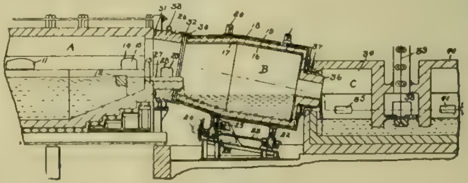
1,577,543.—**Method of and Apparatus for Severing** Glass. Ernest C. Schrader, Toledo, Ohio, assignor to The Libbey Glass Manufacturing Company, Toledo, Ohio, a Corporation of Ohio. Filed March 26, 1923. Serial No. 627,762. 8 Claims. (Cl. 49—2.)

1. A method of making glass articles, comprising blowing an article with a bead between the point of its attachment to the blow iron and the line of severance of the moil, utilizing the bead to apply stretching strain to said line of severance, and melting the glass along said line while the strain is being applied.

1,577,581.—**Apparatus for Glazing Edges of Glassware.** Albert Breakenridge Knight, Fairmont, W. Va. Filed December 13, 1923. Serial No. 680,518 2 Claims. (Cl. 49—58.)

1. A device of the character described comprising a pre-heating hood, means for heating said hood, a heat retaining hood in alignment therewith and spaced therefrom, a conveyor adapted to move articles of glassware through said hoods, and a burner mounted between said hoods.

1,577,602.—**Process and Apparatus for Refining Glass.** Walter O. Amsler, Toledo, Ohio. Filed March 30, 1925. Serial No. 19,265. 12 Claims. (Cl. 49—54.)



1. The process which consists in melting glass, introducing the molten glass into one end of a refining pool, refining the glass in the pool while rolling it about the longitudinal axis of the pool, and discharging the refined glass from the other end of the pool.

1,577,654.—**Process and Apparatus for Burning Off Glassware.** Alvah C. Parker, Toledo, Ohio, assignor to The Libbey Glass Manufacturing Co., Toledo, Ohio a Corporation of Ohio. Filed February 4, 1924. Serial No. 690,409. 18 Claims. (Cl. 49—50.)

1. In apparatus for severing glass articles, a holder adapted to support an article from one end, a guide adapted to be positioned in close proximity to but normally out of engagement therewith outside of the other end of the article, and a burner adapted to apply a melting flame across the glass between the holder and guide.

17. The process of burning off glass articles, which consists in applying to the glass along a line of desired severance a flame sufficiently intense to melt the glass and produce a severed edge along said line and, after said edge is produced, applying thereto a less intense flame to fire-finish the same.

1,577,655.—**Method of and Apparatus for Burning Off Glassware.** Alvah C. Parker, Toledo, Ohio, assignor to The Libbey Glass Manufacturing Company, a Corporation of Ohio. Filed May 16, 1924. Serial No. 713,709. 13 Claims. (Cl. 49—50.)

1. In a glass severing device, a chuck, a burner in position to apply a melting-off flame to a glass article in the chuck, automatic means to vary the intensity of the flame, and synchronized automatic means for moving the chuck a slight distance away from the burner at a predetermined time during a period of intensified flame.

1,577,656.—**Automatic Burning Off Machine.** Alvah C. Parker, Toledo, Ohio, assignor to The Libbey Glass Manufacturing Company, a Corporation of Ohio. Filed Oct. 17, 1924. Serial No. 744,135. Renewed December 23, 1925. 30 Claims. (Cl. 49—50.)

1. In glass working apparatus, a vertically reciprocable chuck, a horizontally movable charging table having an article holder, and automatic means to reciprocate the table and thereby move the holder between a position in alignment with the chuck and a position at one side thereof.

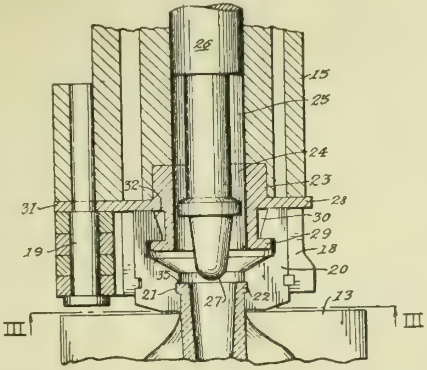
1,578,098.—**Method and Apparatus for Burning Off Glass.** Ernest C. Schrader, Morgantown, W. Va., assignor to The Libbey Glass Manufacturing Company, a Corporation of Ohio. Filed June 14, 1924. Serial No. 720,107. 12 Claims. (Cl. 49—50.)

1. The process which consists in impinging a flame upon glass along substantially the entire length of a line where severance is desired, maintaining the flame until severance of the glass, at such intensity that severance occurs without material deformation of the glass, and, while the severed edge is in the condition in which it is left by said severance, playing a flame simultaneously across substantially the entire length of the severed edge at a short distance therefrom and fire-finishing the same.

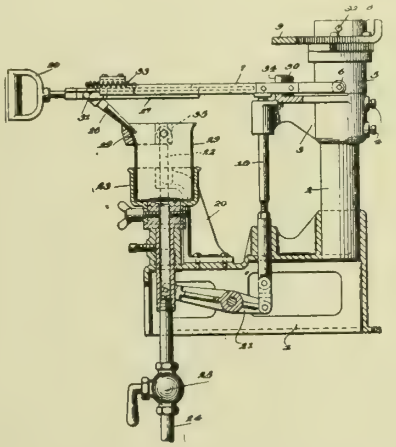
GRANTED MARCH 30, 1926.

1,578,400.—**Machine for Blowing Glass Articles.** Albert N. Cramer, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Filed November 21, 1923. Serial No. 676,135. 3 Claims. (Cl. 49—18.)

1. The combination of a mold comprising arms hinged to swing about a common axis and a thimble comprising separable sections carried respectively by said arms, an adapter arranged to be surrounded by the thimble when the mold is closed, said adapter having a supporting surface in a plane perpendicular to said axis, said thimble sections being formed to engage said supporting surface and thereby support the thimble sections during their opening and closing movements.



1,578,427.—**Apparatus for Shaping Glass Articles.** David E. Gray, Harry R. Boals, and James Bailey, Corning, N. Y., assignors to Corning Glass Works, Corning, N. Y., a Corporation of New York. Filed December 10, 1923. Serial No. 679,765. 9 Claims. (Cl. 49—7.)



2. A glass shaping machine comprising, in combination, ware retaining means, means for heating the ware, a mold shiftable with respect to said ware retaining means, and laterally operable means for giving the ware the shape of the mold.

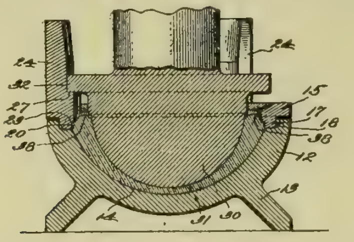
1,578,442.—**Manufacture of Glassware.** August Kadow, Toledo, Ohio, assignor to The Libbey Glass Manufacturing Company, Toledo, Ohio, a Corporation of Ohio. Filed March 27, 1922. Serial No. 547,011. 24 Claims. (Cl. 49—17.)

1. The method of forming glassware, which consists in gathering from a source of supply a quantity of molten glass into a gathering member, removing the charged gathering member from the source of supply, holding one portion of the glass in the gathering member and applying a stretching pull to another portion of the glass to draw it in predetermined form from the gathering member.

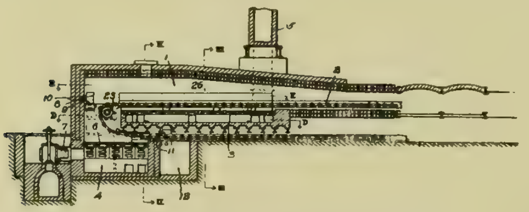
1,578,448.—**Method of Pressing Glass.** States Lee Lebby, Corning, N. Y. Filed July 16, 1925. Serial No. 44,075. 3 Claims. (Cl. 49—85.)

1. The method of preventing " sucks " in a pressed

glass blank which comprises confining the shrinkage of the blank to a zone having unpressed walls and forming an optically non-essential portion of the blank.



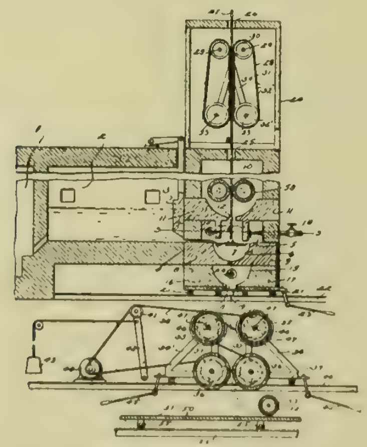
1,578,792.—**Leer for Glassware and Other Articles.** Walter O. Amsler, Toledo, Ohio. Filed April 1, 1925. Serial No. 19,858. 5 Claims. (Cl. 49—47.)



2. In annealing apparatus an elongate horizontally extending chamber, the floor of said chamber being formed in a plurality of sections arranged at different levels, conveying means entering the chamber between the said floor sections and then advancing above the upper floor section, and means for causing a stream of hot gases to flow externally of said floor structure, first beneath the lower floor section and then beneath the upper floor section.

5. In annealing apparatus an elongate, horizontally extending chamber, means for heating the floor of the chamber, a horizontally extending conveyor movable longitudinally within the chamber and at an interval above the floor and at an interval from the side walls of the chamber, and a shield extending parallel with and at an interval from the side walls of the chamber and extending from above to a level lower than the level of the conveyor.

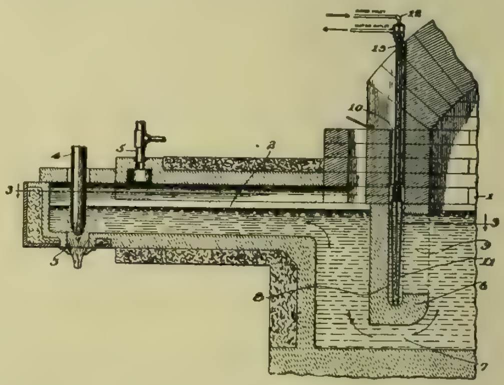
1,578,926.—**Glass-Making Machine.** George A. Shields, Columbus, Ohio. Filed February 19, 1923. Serial No. 619,916. 5 Claims. (Cl. 49—3.)



1. In a glass machine, a flow chamber including a trough for receiving molten glass, a drawing chamber above the flow chamber, a supplemental chamber below the flow chamber, an elevating mechanism mounted above the drawing chamber, said drawing chamber being in communication with the housing to permit sheet glass to be drawn from the drawing chamber for engagement with the elevating mechanism, said trough and supplemental chamber including separable sections for simultaneous movement away from each other to permit glass to flow in a downward direction from the trough and through the supplemental chamber.
Granted April 6th, 1926.

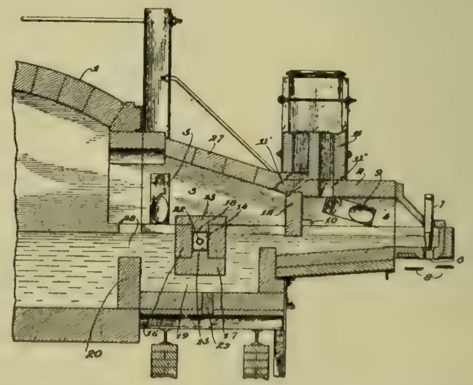
GRANTED APRIL 6, 1926.

1,579,353.—**Water-Cooled Bridge.** Robert Good, Washington, Pa. Filed November 1, 1924. Serial No. 747,360. 20 Claims. (Cl. 49—55.)



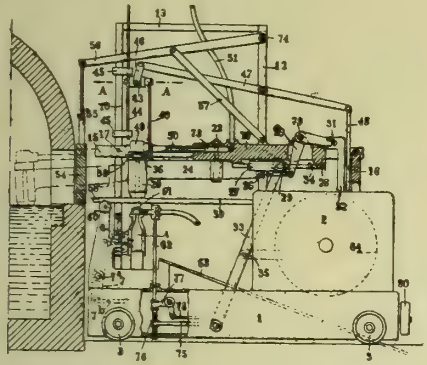
20. A glass furnace including an individual bridge, said bridge having a pocket therein, and said bridge also having means to permit the flow of glass from the melting tank to the pocket and *vice versa*, a cooler adapted to be inserted in said poket, said cooler comprising a hollow metallic member and water inlet and outlet pipes associated with said hollow member, the water inlet pipe extending to a point adjacent the bottom of the hollow member.

1,579,364.—**Individual Bridge Wall for Flow Spouts.** Glen E. Henning, Wheeling, W. Va., assignor to Hazel-Atlas Glass Co., Wheeling, W. Va., a Corporation of West Virginia. Filed March 2, 1925. Serial No. 12,679. 36 Claims. (Cl. 49—55.)



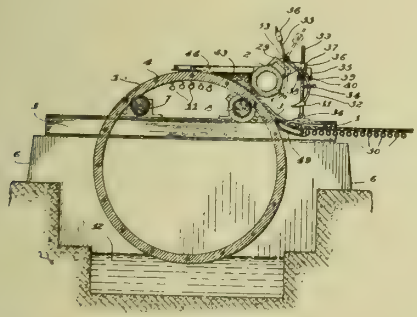
1. In a glass furnace, the combination of a bridgeless tank, a flow spout communicating therewith, and an individual bridge wall provided in said flow spout.

1,579,396.—**Automatic Machine for Manufacturing Blown-Glass Articles.** Emile Roirant, Paris, France, assignor to Société Anonyme d'Etude et de Constructions d'Appareils Mecaniques pour la Verrerie, Paris, France. Filed March 20, 1924. Serial No. 700,682. 7 Claims. (Cl. 49—5.)



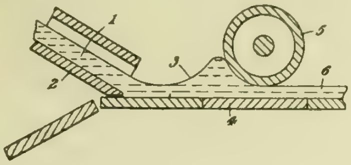
1. An automatic machine for the mechanical manufacture of blown glass articles comprising: a rough-shaping mold, means for imparting a horizontal displacement to said mold, means for giving this mold an ascending and descending movement at one of the ends of its rectilinear course, a finishing mold, a ring or collar mold, means for alternately bringing the ring mold into co-operation with the rough-shaping mold for the formation of the parison or preliminary mass of glass, and with the finishing mold for the conveyance of the said mass to the latter, a blowing bell, and means for bringing this bell to the finishing mold after the departure of the ring mold on delivery of the parison to the said finishing mold.

1,579,666.—**Apparatus for Making Sheet Glass.** Lee Showers, Charleroi, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed July 9, 1925. Serial No. 42,467. 17 Claims. (Cl. 49—33.)



1. In combination in apparatus for making sheet glass, a casting table in the form of an annular shell of large diameter, roller means for supporting said shell for rotation, a driven sizing roll in opposition to the periphery of the shell positioned so as to provide between the shell and roll a pocket for receiving the molten glass to be rolled, end walls for the said pocket, and a runway for receiving the ribbon or sheet of glass formed between the shell and sizing roll.

1,579,825.—**Production of Continuous Strips of Glass and Apparatus Therefor.** Ernest Bristow Le Mare, St. Helens, England, assignor to Pilkington Brothers Limited, Liverpool, England, a British Company. Filed September 16, 1924. Serial No. 738,046. 12 Claims. (Cl. 49—33.)



1. Process of producing a continuous strip of glass consisting in forming a pool of molten metal leading to a pass which forms the strip, the pass dimensions being substantially equal to the thickness of the strip and greater than the width of the strip, characterized by the pool being unconfined in respect to its edges up to and through the pass, but confined in respect to its back end.

BRITISH PATENTS.

The following abstracts are taken from the Illustrated Official Journal of Patents with the special permission of the Controller of H.M. Stationery Office.

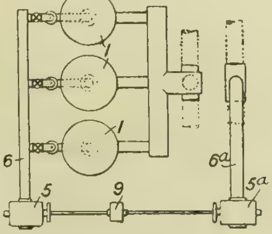
Printed copies of the full specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C., price 1/- each.

247,206.—**Stained Glass.** Le Roy, G., Marly-le-Roi, Seine-et-Oise, France. Feb. 4, 1926. No. 3,292. Convention date, Feb. 7, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 20 (iii).)

Transparencies; compound sheets.—Stained glass for windows, lamp-shades, etc., is made from pieces consisting of photographs, lithographs, transfers, line, pencil, or brush drawings, etc., on transparent film, enclosed between two pieces of glass, the film and glass being cut out according to templets. The film may be coloured by toning, dyeing, staining, etc., or additional coloured film may be enclosed, or coloured glass may be used. False leads may be applied to one or both of the glass sheets to dispense with cutting of the glass.

247,215.—**Furnaces.** Steinbart, A., Pittsburg, U.S.A. Feb. 5, 1926. No. 3,405. Convention date, February 7, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 51 (i).)

FIG.I.



Air supply, regulating.—In furnaces fired with producer gas, the supply of primary air to the gas producers and of secondary air to effect combustion of the gas in the furnace are regulated in such a manner that they are always maintained in a predetermined proportion according to the nature of the fuel supplied to the producers. As shown in Fig. 1, blowers 5, 5a driven directly by a motor 9 deliver air in definite proportions through pipes 6, 6a respectively to the producers 1 and to the furnace. If desired, change-speed gear may be arranged between the motor and one of the blowers.

FIG.3.

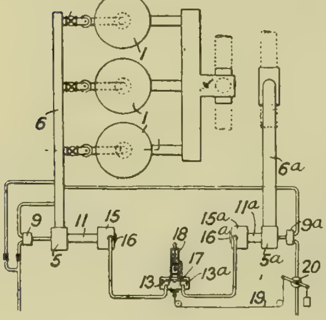
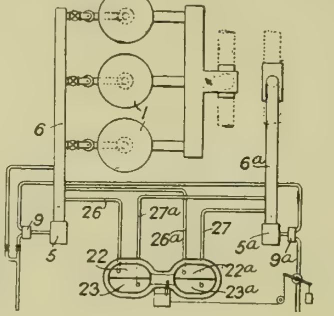


FIG.5.



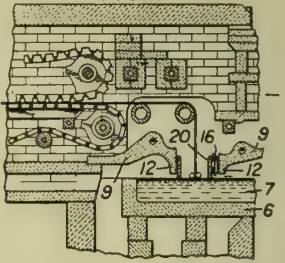
In the modification shown in Fig. 3, the suction pipes 11, 11a of the blowers, 5, 5a driven by steam turbines 9, 9a are provided with stabilizing-chambers 15, 15a having inlet orifices 16, 16a about one-half of the areas of the inlet ports of their respective blowers. The areas of the orifices 16, 16a are also proportional to the primary and secondary air supplies. The pressure in the stabilizing-chambers is communicated to liquid sealed bells 13, 13a mounted on a lever 17. Upon starting the blower 5, the bell 13 is lowered and the lever 17 controls a motor 18 connected through a cord 19 to a valve 20 so as to admit steam to the turbine 9a and start the fan 5a. The static pressure in the chamber 15a is reduced and the bells 13, 13a come to rest in their normal position, the supplies of primary and secondary air being maintained in the correct proportion. In a further modification shown in Fig. 5, the bells are each divided into two compartments 22, 23, and 22a, 23a. The compartments 22, 22a are connected by pipes 26, 26a to the primary air supply main 6 so as to be actuated by the flow of air therein and the compartments 23, 23a are similarly connected through pipes 27, 27a to the main 6a so as to be actuated by the flow of secondary air. The bells are arranged to operate the valve 20 as described above. Instead of controlling the secondary air in accordance with the primary air, the operation may be reversed. Steam jet blowers may be provided for supplying air to the producers.

247,483.—**Stoppers.** Lunn, J., and Lunn, E., 52, Mount Street, Glasgow. September 5, 1925. No. 22,186. Drawings to Specification (Class 125 (iii).)

Stoppers, screw; stoppers, plug.—In a bottle stopper having a rigid flange or skirt depending from its top portion, the skirt is formed with a cylindrical external surface and a conical internal surface of such diameter as to leave a small clearance between it and the bottle neck, the skirt being deep enough to cover the portion of the neck to which matter is likely to adhere. The invention is applicable to screw or plain plug stoppers. Specifications 12,897/86, 17,277/89, and 3,873/02 are referred to.

247,489.—**Glass manufacture.** Golby, F. W., 3, John Street, Bedford Row, London. (Libbey-Owens Sheet Glass Co.; 608, Madison Avenue, Toledo, Ohio, U.S.A.) September 23, 1925. No. 23,732. (Class 56.)

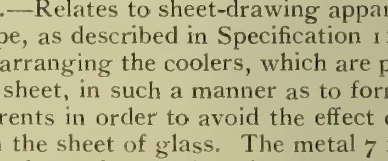
FIG.1.



Drawing.—Relates to sheet-drawing apparatus of the Colburn type, as described in Specification 114,977, and consists in arranging the coolers, which are placed adjacent to the sheet, in such a manner as to form a flue for hot air currents in order to avoid the effect of these air currents on the sheet of glass. The metal 7 from which the sheet is drawn is contained in a pot 6, and tiles 9, supported above the surface of the metal, have downwardly-extending lip portions 12 which terminate at a distance above the glass level. In accordance with the invention, one of the coolers 16 is mounted so that its lower edge is approximately flush with the lower edge of the lip 12 and preferably close to the tile. A second cooler 20 is positioned with its lower edge close to the surface of the metal 7. The two coolers so arranged form a flue, and the hot air currents deflected downward by the tile 9 pass up the space between the coolers.

247,862.—**Glass Manufacture.** Golby, F. W., 3, John Street, Bedford Row, London.—(Libbey-Owens Sheet Glass Co.; 608, Madison Avenue, Toledo, Ohio, U.S.A.). September 23, 1925. No. 23,731. (Class 56.)

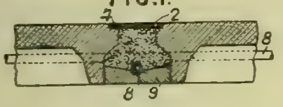
FIG.1.



Drawing.—Relates to sheet-drawing apparatus of the Colburn type, as described in Specification 114,977, and consists in applying drawing-forces to the sheet edges at a series of spaced points and at successively greater drawing-speeds as the sheet is drawn away from its its source. The sheet 1 is drawn upwards from a mass of metal 2 towards a bending-roll 4, and each of its edges is gripped near its source by a pair of rollers 7. These rollers are driven at a slower peripheral speed than the speed of the sheet in order to maintain the width of the sheet. In accordance with the invention, a second pair of rollers, 9, is arranged to grip each edge of the sheet at a point between the first pair and the bending-roll, and they are driven at a peripheral speed between that of the first pair, 7, and that of the bending-roll. Due to the additional stretching-force applied by the rolls 9, the narrowing of the sheet which usually takes place between the rolls 7 and the bending-roll, and also the tendency to form surface inequalities, is reduced. The rollers 7, 9 need not be cylindrical but may be shaped to form a thicker edge or bead on the sheet.

247,918.—**Pavement Lights.** Liese, P., 44, Dreibundstrasse, Tempelhof, Berlin. November 20, 1925. No. 29,349. Convention date, February 17. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 20 (iii).)

FIG.1.



Pavement lights and like glazed gratings; glazing.—Composite glass and reinforced-concrete structures are enabled to expand, etc., under the influence of moisture and changing temperature, and replacement of the glass blocks is facilitated, by making the concrete supports 2 widen towards the inside without contraction. The joint between the glass and concrete is covered by a layer 4 of asphalt, etc., which may be keyed by suitable recesses in the glass. The reinforcement 8 is positioned by spacing slabs 9 of artificial stone, iron, etc. The reinforcement may be a grid or expanded metal apertured to the shape of the glass blocks and positioned over metal, etc., supports suitably recessed to engage the feet of the blocks. Rods for reinforcement may be carried on short tubes secured to a base-plate and widened at the top or by metal straps embracing the rods and resting on the plate.

247,994.—**Refractory Materials.** Trippensee, A., 146, Sofienstrasse, Karlsruhe, Baden, Germany. February 20, 1926. No. 4,956. Convention date, February 23, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 22.)

Refractory substances containing siliceous materials.—Portland cement is used as a binding-agent for refractory materials such as ground chamotte, quartzite, sandstone, or siliceous sand, or mixtures of these substances. The composition may be either used directly to build up furnace linings, etc., *in situ*, or it may be pressed into bricks, blocks, etc., which do not require to be burned.

Latest British Patents.

Applications for Patents.

7856.—March 22, 1926. G. Wise. Containers for pouring liquids.
7898.—March 22, 1926. (United States, March 20, 1925). E. G. Bailey. Furnaces.
7974.—March 23, 1926. F. H. Le Sueur. Non-refillable bottle.
7994.—March 23, 1926. (Belgium, March 28, 1925). C. Heuze. Manufacture of plate glass etc.
8034.—March 24, 1926. W. L. Marrian. Ink bottles, etc.
8065.—March 24, 1926. (Switzerland, March 24, 1925). A. Waldmeier. Optical projection apparatus.
8158.—March 25, 1926. B. Feldmann. Dewar bottles.
8178.—March 25, 1926. E. Feuerheerd. Rotary air compressors, etc.
8206.—March 25, 1926. J. H. Reineke, Unipressure, Ltd. Fuel supply to furnaces, etc.
8207.—March 25, 1926. J. H. Reineke, Unipressure, Ltd Furnaces.
8210.—March 25, 1926. F. H. Bull. Stoppers for jars, etc.
8213.—March 25, 1926. A. E. A. Akers. Medicine etc. bottles.
8313.—March 26, 1926. J. H. Reineke, Unipressure, Ltd. Apparatus for controlling supply of air etc. to gaseous fuels.
8468.—March 29, 1926. P. Swan. Stoppers for bottles, etc.
8752.—March 31, 1926. A. E. Beck. Glazing of roofs, etc.
8800.—April 1, 1926. (Germany May 6, 1925). C. Zeiss (firm of). Spectacle glasses.
8907.—April 1, 1926. (Japan, April 4, 1925). I. Kitajima. Lenses.
8919. April 1, 1926. C. G. Redfern. (American Optical Co.). Opthalmic lenses.
8921.—April 1, 1926. (Holland, May 11, 1925). Naamlooze Venootschap Philips' Gloeilampenfabrieken. Sealing metal in or to glass.
8968.—April 6, 1926. J. Fallon. Furnaces.
9050.—April 6, 1926. J. Reid. Furnaces.
9212.—April 7, 1926. G. B. Riley, Safetex Glass, Ltd. Reinforced glass.
9220.—April 7, 1926. H. Panzetta. Stoppers for jars, etc.
9244.—April 7, 1926. F. W. Clark. Manufacture of gas from coal, etc.
9259.—April 8, 1926. J. Fallon. Furnaces.
9300.—April 8, 1926. (France, June 20, 1925). Soc. Anon. des Manufactures des Glaces et Produits Chimniques de Saint-Gobain, Chauny et Cirey. Apparatus for manufacture of sheet glass.
9315.—April 8, 1926. J. S. Russell. Furnaces.
9430.—April 9, 1926. (United States, April 9, 1925). British Thomson Houston Co., Ltd. Apparatus for making incandescent lamps.
9449.—April 9, 1926. Carborundum Co., Ltd. (Carborundum Co.). Manufacture of refractory articles.
9509.—April 10, 1926. A. E. Horne. Device for cutting glass tubes.
9516.—April 10, 1926. (Power Speciality Co.). Furnaces.
9517.—April 10, 1926. (Power Speciality Co.). Furnaces.
9518.—April 10, 1926. (Power Speciality Co.). Furnaces.
9550.—April 12, 1926. A. Cohen. Photographic lenses.
9634.—April 12, 1926. Albro Fillers and Engineering Co., Ltd. Machine for pressing stoppers into bottles, etc.
9673.—April 13, 1926. E. A. Jones. R. Thomas and Co., Ltd. Valves for furnaces, gas producers, etc.
9718.—April 13, 1926. (Lampen-u. Metallwaren-Fabriken R. Ditmar Geb. Brunner Akt. Ges.), R. R. Tugwood. Production of flexible mirrors.
9740.—April 13, 1926. F. G. Ginzler. Closures for jars, etc.
9819.—April 14, 1926. S. Black. Apparatus for sealing milk etc. bottles.
9935.—April 15 1926. F. H. Le Sueur. Non-refillable bottle.
10015.—April 16, 1926. J. N. Aldington, P. D. Oakley, Siemens and English Electric Lamp Co., Ltd. Frosting glass.
10098.—April 16, 1926. E. S. Butler, E. B. Norman, C. J. Reilly. Nursing bottles.

Specifications Published.

226182.—December 11, 1923. .(Addition to 218286) Janaer Glaswerk Schott and Gen. Filters.
238562.—August 14, 1924. (Addition to 194819) T. Teisen. Crucible and like furnaces.
241206.—October 9, 1924. Soc. Anon. des Manufactures des Glaces et Produits Chimiques de Saint Gobain. Chauny and Cirey. Apparatus for the manufacture of sheet glass.
241207.—October 10, 1924. Soc. Anon. des Manufactures des Glaces et Produits Chimiques de Saint Gobain. Chauny and Cirey. Means for conducting or guiding glass in the manufacture of rolled sheet glass.
241544.—October 20, 1924. British Thomson-Houston Co., Ltd. Methods and apparatus for making elongated articles of vitreous silica, such as tubes and rods.
249256.—January 15, 1925. B. H. Nolland. Air regulating means for liquid fuel furnaces.

249336.—April 14, 1925. C. A. Jensen (American Dairy Supply Supply Co.). Machine for making caps or closures for bottles, jars, and like containers.

249423.—October 9, 1925. O. T. Clorius. Thermometers or the like.

249589.—November 29, 1924. (Cognate Application 12886/25). J. W. Sutcliffe. Sealing jars and like containers.

249636.—February 9, 1925. C. E. Frazier. Annealing furnaces.

249648.—February 19, 1925. G. W. Bennett. Means for attaching glass splash plates and like articles to walls.

249695.—May 19, 1925. A. E. Bartlett. Bottles for liquids containing sediment.

249738.—August 24, 1925. M. H. McMann. Bottle, jar and the like closing devices.

249741.—August 28, 1925. Presscaps, Ltd. J. S. Franklin. Apparatus for fixing capsules or sealing bands on bottles or other containers.

249796.—November 14, 1925. General Electric Co., Ltd. Manufacture of electric lamps with light diffusing or coloured bulbs.

249797.—November 14, 1925. General Electric Co., Ltd. Manufacture of electric lamps with light diffusing or coloured bulbs.

249919.—December 31, 1924. T. Teisen. Apparatus for effecting the transfer of heat between gases.

249988.—February 24, 1925. (Patent of Addition not granted). J. Schwarzkopf Polishing compositions.

250045.—May 15, 1925. I. Warner. Lime burning process.

250064.—June 25, 1925. F. F. Bello. Means for severing glass tubes, decanters, rods, and like glass pieces.

250149.—January 15, 1926. H. H. Zeal. Thermometers.

250354.—February 2, 1925. Grosvenor Scientific Products, Ltd. B. Turner. Refractory material.

250393.—April 15, 1925. Butterley Co. G. F. Wright. Rotary screens for grading small coal and other materials.

250462.—September 8, 1925. J. E. Pollak (Owens Bottle Co.). Apparatus for receiving and conveying articles from a glassware forming machine.

250479.—October 18, 1925. J. B. Sanders. Bottle which cannot be refilled.

250480.—October 24, 1925. R. H. Youngman. Unburned refractory brick.

Specifications Open to Public Inspection.

249461.—March 23, 1925. P. Rostaing. Apparatus for finishing glass or like articles on a grinding wheel.

249484.—March 20, 1925. G. Michel. Process for the protection of readily oxidizable metals.

249540.—March 19, 1925. British Thomson Houston Co., Ltd. Marking of incandescent lamps and similar articles.

249544.—March 18, 1925. Soc. Nouvelle de Metallisation. Process for the rust protection of metallic objects which are subjected to high temperatures in an oxidizing environment.

249551.—March 19, 1925. G. J. Hendriks. Polishing machines.

249554.—March 23, 1925. C. E. Cornelius. Electric furnaces for melting or producing glass, waterglass, cement, or other substances.

249863.—March 28, 1925. C. Heuze. Process and apparatus for the manufacture of plate glass, special and wired glass and the like.

249894.—April 19, 1924. J. Paisseau. Supports for use in the manufacture of glass or enamel beads.

250192.—March 31, 1925. J. E. Renodier. Machines for making glass bottles and the like.

250201.—March 31, 1925. Hartford Empire Co. Annealing of glassware.

250201.—March 31, 1925. Hartford Empire Co. Annealing of glassware.

250268.—April 4, 1925. I. Kitajima. Lenses.

250536.—April 10, 1925. Soc. Anon. des Manufactures des Glaces et Produits Chimiques de St. Gobain, Chauny, et Cirey. Process and apparatus for fining glass.

250537.—April 11, 1925. Soc. Anon. des Manufactures des Glaces et Produits Chimiques de St. Gobain, Chauny, et Cirey. Process and apparatus for the continuous manufacture of reinforced glass.

250554.—April 9, 1925. Brun et Cie. Sand and like washing machines.

250556.—April 8, 1925. A. M. Jorgensen. Machine for closing bottles and similar containers by means of discs of cardboard or other material.

250558.—April 7, 1925. L. Anker (firm of). Methods of and machines for attaching leaf metal to bottles.

Patents, Trade Marks, Inventions.—Advice, Handbook and Consultations free. King's Patent Agency Ltd., Director B. T. King, C.I.M.E., Regd. Patent Agent, G.B., U.S., and Canada, 146a, Queen Victoria Street, E.C.4, and 6, Quality Court (next Patent Office), London, W.C. 39 years' references. 'Phone: Cent. 682.

GLASS RESEARCH ASSOCIATION.

Wanted, copies of Nos. 1 and 2 of the Glass Research Association Bulletins. Box 306, Glass Publications Ltd.

MANUFACTURERS.

Required glass manufacturer to undertake the manufacture of large high grade heat resisting globes, for totally enclosed arc lamps. Write Box No. 305.

WANTED.

Advertiser is desirous of purchasing several Lynch machines type L.A. Must be good condition. Reply giving machine numbers, date of installation and where they may be inspected, to Box No. 304, Glass Publications Ltd., Talbot House, Arundel Street, Strand, London, W.C.2.

Prevailing Prices.

Arsenic (Continental or Japanese)	£15	15	0	ton
Arsenic (Refined white powdered)	£15	10	0	ton
Cobalt (Black Oxide)	*£0	8	0	lb.
Cobalt (Grey Oxide)	*£0	8	10	lb.
Cryolite (Synthetic) 99/100%	†£37	0	0	ton
Manganese Peroxide 85/87%	*£19	10	0	ton
Potash (Hydrated Carbonate) 83/85%	†£22	10	0	ton
Potassium Nitrate	*£24	0	0	ton
Red Lead, Finest English Manufacturing Glass Makers' quality	*£2	5	0	cwt.
Selenium (Black powdered) 99/100%	*£0	8	0	lb.
Soda Ash (Heavy)	£6	5	0	ton
Soda Ash (Light)	£5	17	6	ton
Sodium Nitrate (Refined Chilean) 96%	£13	7	6	ton
Sodium Nitrate (Synthetic) 96%	†£13	10	0	ton
Sodium Selenite	*£0	5	6	lb.
Sodium Silico Fluoride	*£17	0	0	ton

The above prices are for usual commercial quantities.

* d/d. Works.

† c.i.f. U.K. port.

Vitreous Enamel Colours.

Stains for Glass.

Oxides for Colouring Glass Metal.

Selenium Metal.

Selenate and Selenite of Soda.

GROUND BONE, FELSPAR FLINT, FLUORSPAR, QUARTZ, STONE, WHITING, ETC.,

CARBONATE & SULPHATE OF BARYTES

OXIDES OF ANTIMONY, ARSENIC, CHROME, COBALT, SMALTS, COPPER, IRON, MANGANESE, NICKEL, TIN, TITANIUM, URANIUM, ZINC, ETC

TRADE CERAMIC MARK

WENGERS, LTD.

CERAMIC COLOURS & CHEMICALS

ETRURIA.

STOKE-ON-TRENT.

England.

Samples & Price Lists Sent on Demand.

COLOURS FOR POTTERS, GLAZED BRICK MANUFACTURERS, & GLASSMAKERS.

PREPARED ENAMELS FOR CAST & SHEET IRON, COPPER & JEWELLERY.

Limespar.

Phosphate of Lime.

Nitrate of Soda.

Nitrate of Potash.

Opavetro for Opacifying Glass.

Alumina, Oxide and Hydrate.

GLASS

THE RECOGNIZED ORGAN OF THE GLASS INDUSTRY
Published on the Tenth of Each Month.

Single Copies - - - - One Shilling
Annual Subscription - - 10/6 post free

GLASS PUBLICATIONS Ltd.
TECHNICAL PUBLISHERS,
Talbot House,
Arundel Street,
Telephone: Central 5985. **Strand, London, W.C.2.**

CONTENTS.

PAGE
Editorial Notes ... 263
Practical Notes on the Thermal Endurance of Glass.—By H. V. E. Renn ... 264
The Bulb Making Plant of the General Electric Company at Wembley ... 269
Refractories for the Glass Industry.—By W. J. Rees, B.Sc., Tech., F.I.C. (Lecturer in Refractories, University of Sheffield) ... 275
The Belgian Glass Industry ... 283
Trade Notes ... 285
The Society of Glass Technology ... 287
The British Refractories Research Association: A Brief Review of Its Work ... 289
New Type Furnace ... 294
Sulphur in Producer Gas ... 294
Heat Recovery in Glass Furnaces ... 294
The Source of the Coloured Glass used in Mediaeval Stained Glass Windows.—By John A. Knowles ... 295
The Increased Optical Glass Duties.—By Our City Correspondent ... 297
April Trade Returns ... 299
United States Patents ... 300
British Patents ... 305
Latest British Patents ... 308

Editorial Notes.

There have been many attempts to estimate the cost to the nation of the recent fool-hardy attempt to establish a species of Soviet Britain and naturally the results vary between very wide limits. It is safe to say, however, that what may be termed the immediate cash cost of defeating the attack is much less than it might have been, whilst at the present time it is impossible to estimate the amount to be added for lost business.

It should not be forgotten, however, that although the total figure may be large it should not be considered as a complete *loss* but rather as a purchase price, because something has and will be obtained in return for the money expended, and it is a something which will be of real value to the industries of the nation and therefore to the nation itself. This will result from the absolutely unconditional nature of the surrender of the T.U.C. and its affiliated Unions, as there is little doubt that it marked the end of the period of abuse and prostitution of the power of trades unionism by some of the alleged leaders whose attitude towards agreements, etc., has invariably been of the "heads I win, tails you lose" order. (Incidentally not the least amusing occurrence during the strike was the frequent use of the term "honourable" by the T.U.C. when referring to negotiations.)

The thinking workmen, and they are many, have had a bitter lesson with the opportunity of realising how badly they have been advised in the past; consequently there is good reason to suppose that in the near future many leaders, whose names have been something to conjure with, will recede into obscurity once more.

If an internal re-organisation can take place, supported by adjustments and amendments as to their legal situation, Unions will once more become of general and legitimate service and use, and employers will be able to exercise a little control in their own works, whilst the men themselves will benefit to an even greater extent as they will have destroyed a parasitic growth that was obtaining a hold which would have eventually spelt ruin for all.

Just prior to the strike there was a steady reduction, week by week, in the number of unemployed and trade *was* slowly improving. If this could take place under the old conditions, it is not too much to hope that under the new we can quickly make up the loss, and finally get back to prosperity all round.

This, of course, is subject to an early settlement of the coal dispute, which, though less spectacular, is a greater danger than the general hold-up. Here again, whilst numerous district representatives of the men are sincere in their opinion and belief that they are working in the men's interests, the same cannot be said of many of the chief officials, who have become mere puppets acting in response to strings pulled by their masters in Russia.

In the meantime each day sees more and more men in other industries being put out of work due to lack of coal and we are losing orders from markets it will be difficult if not impossible to recapture. Even the home consumption will be reduced because numerous factories —including glass works—are being equipped for burning oil fuel, with the result that when the dispute is settled the conditions of the coal industry will be worse than they were at the commencement; and one would have thought that the experience of the results of past strikes would have been sufficient to convince the men of the futility of a general stoppage of the whole of an important key industry as a means of solving what is really an economic problem.

[Glass *will deal with all matters pertaining to the industry in an impartial manner, consequently the Editor does not necessarily associate himself with the opinions expressed by his contributors.*]

Practical Notes on the Thermal Endurance of Glass.

By H. V. E. RENN.

Mechanical Strength.

The earlier attempts to promote resistance to thermal shock in glass were mostly in the direction of increasing the mechanical strength. Advantage was taken of the fact that power to resist compression is greater than power to resist pull, and methods of treatment were devised whereby a compressive stress was set up in the outer layers of the glass while the inner layers were in tension.

The attempts to increase the mechanical strength were doubtless prompted by a comparison of the properties of glass with those of metals. Glass possesses the advantage over iron, for example, of smaller thermal expansion and greater specific heat, but on the other hand, the iron is greatly superior in thermal conductivity and tenacity. This is readily seen by a glance at the average values set out in the following table :—

Table I.

	Glass.	Iron (Cast).
Cubical Expansion	0.000026	0.000033
Thermal conductivity	0.0021	0.114
Specific heat	0.198	0.13
Tensile strength	3½ tons/sq. in.	12 tons/sq.in.

The great superiority of metals in withstanding thermal shock is almost entirely due to their great mechanical strength and the first attempts to increase the thermal endurance of glass were based upon this fact.

The earliest process was that of la Bastie, which was published something over half a century ago. The glass articles to be hardened were heated to softening point and then plunged into a bath of a hot mixture of oils, wax, resin, and similar ingredients. By this means a condition was established that may be described as toughening or case-hardening and glass so treated was found to be of improved mechanical and thermal endurance. Vessels of thin glass, such as beakers, treated by la Bastie's process could be used for boiling water in direct contact with the flame without fracture, while they successfully resisted the shock produced by dropping upon them metal weights from a considerable height.

Efforts were made in this country to apply the process to various articles of glassware, especially laboratory ware, but without success, for experiments showed that a slight scratch, such as might be produced by sand in the sand bath, caused the glass either to collapse into a heap of powdered fragments or to fracture violently.

The composition of la Bastie's glass was stated to be that of an ordinary soda-lime glass with about 2 per cent. of alumina, so that the toughening effect was obviously not in any way due to the composition of the glass.

A careful investigation of toughened glass was made by Lord Rayleigh.* An examination under the polariscope revealed the presence of severe stresses. When examined through the thickness of the sheet a revival of light was observed with intermediate irregularly disposed dark bands. The course of these bands was altered upon relieving any part from the constraining influence of neighbouring parts by fracture. In order to examine the conditions by light transmitted through the section of the glass, i.e. edgewise, the glass was immersed in a liquid of nearly equal refractivity. Benzole with a small addition of carbon bisulphide was found suitable for this purpose. The stress at the middle was nearly sufficient to give the yellow or brown of the first order, but the dark bands of no double refraction seemed nearer to the faces than according to theory. After an outermost layer had been removed by means of hydrofluoric acid, an examination showed that the dark bands had drawn nearer towards the middle and that the light, i.e. the stressed areas, had considerably decreased.

Rayleigh concluded that the properties of toughened glass were due to the conditions of stress and that superficial compression may possibly be the explanation of the special hardness observed.

The same writer also made some interesting investigations† upon the stresses set up in glass due to unequal heating. For the experiments he used a slab of glass about 8 cm. square, by 1 cm. thick, polished upon opposite edges. He found that stresses were able to be set up by such slight temperature changes as can be produced by the heat of the hands after a few seconds contact with the two faces. Examination under the polariscope showed an almost instantaneous illumination rising to a maximum at the middle of the thickness, while intermediate dark bands were also noted. The rise in temperature at first sets up a compressive stress in the outer layer due to the inability of this layer to expand fully. At the same time the inner layers are in tension. The dark bands indicate the unstressed layers situated between the layers in compression and those in tension. The conditions of stress can be confirmed by interposing another piece of glass, the mechanical condition of which is known, when either an intensification or a diminution of light will be effected.

The method of increasing the mechanical strength of glass by the toughening process has perhaps only one application in practice to-day that is to be recommended. It is a well-known fact that in lamp-working, difficulty is often experienced in sealing platinum wires into ordinary soda glass. Proper enamel can, of course, be procured that enables the lamp-worker to overcome this difficulty, but if this is not to hand at the moment a temporary seal can always be made by aid of the toughening process that will, at any rate, survive the experiment. The wire is well fused into the glass and the whole plunged into a mass of solid paraffin. The method is only to be recommended in cases of emergency where a permanent piece of apparatus is not required, for although the glass may remain intact for a considerable period, the fact that it is not in a stable state must not be overlooked.

---

* Phil. Mag. 1901, 1, 169.

† Loc. Cit.

Various methods have been proposed from time to time in which mechanical strength is promoted in order to offer increased resistance to thermal shock, but the fact that these methods have not survived the test of time is sufficient indication of their unreliability.

One of the most recent devices appeared in a patent specification* in 1922. The glass article is subjected to rapid cooling from a temperature above its annealing point, high velocity air jets being employed for the purpose. The operation is carried out by means of the device shown in Figure 1.

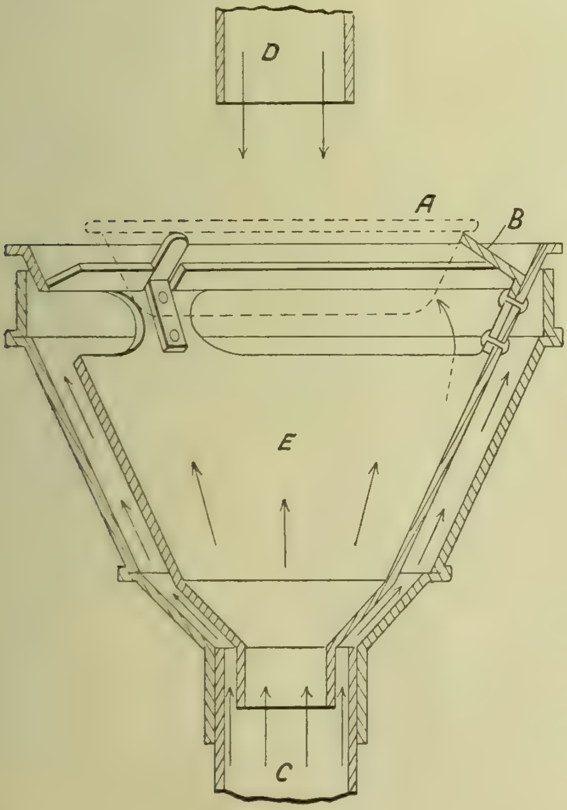


Fig. 1.

The hot glass article A is placed in the holder B above and below which are situated the jets C and D. These are connected to a supply of compressed air and are arranged so that the air will strike the glass article substantially normal to its surface. This is effected with the assistance of a perforated distributing cone E, attached to the lower jet.

Of the earlier methods for the toughening of glass, that of Schott is perhaps the most noteworthy, a description of which was published in 1892.* It was pointed out that by superposing a layer of glass of high expansibility upon one of a lower expansibility that it is possible under suitable conditions to obtain a compensation of expansions. At the time when Schott published his work, it was generally understood when making compound glasses, i.e. the so-called "flashed" or "cased" glasses, that in order to prevent fracture upon cooling, the component glasses should possess as nearly as possible equal co-efficients of expansion. After having investigated the point Schott stated that this view was not altogether correct. By fulfilling certain conditions, it was possible to unite glasses that differed considerably in expansion and that the main condition concerned the relative thickness of the two glasses. Assume a plate to be made from superposed layers of glasses of different expansibilities united when gathered on the blow pipe. If the upper layer is composed of the glass of the greater expansibility a tensile stress will be set up upon cooling, while the under layer will be in compression. This is amply illustrated by the test frequently seen in some glasshouses where compound glasses are manufactured. A thread of the compound glass is drawn out which curls up upon cooling, the glass possessing the greater expansion being on the inside.

The intensities of the stresses set up depend upon numerous factors, but broadly speaking, fracture will occur if the tension in the upper layer exceeds the tensile strength of the glass comprising that layer, or, if the compression in the under layer exceeds the compressive strength for that particular glass. As compressive strength is greater than tensile strength, the upper layer is invariably the one in which fracture originates. To prevent this the upper layer should be made thicker. It has been calculated† that a difference of 60×10^{-7} in the co-efficients of cubical expansion of two component glasses would require a difference in thickness of from 10 to 15 times in order to render the glass secure against fracture.

Schott adopted the principle of covering the glass with a toughened layer in order that it should become more resistant to thermal and mechanical disturbances. He used two methods of fulfilling this condition. A compound glass was employed, the glass possessing the greater expansion being placed outside. This layer would be in tension and would therefore be more sensitive to shock than the inner layer of glass possessing the less expansion which would be in a state of compression. The outer layer was therefore toughened by one of two methods. It was either cooled rapidly in air or it was covered by a very thin layer of glass of smaller expansibility. A glass vessel of this description is able to bear sudden heating on one surface without fracture, despite the fact that such treatment has the effect of increasing the compressive stress already present in the outer layer. This can be readily understood when it is considered that, in the case of a vessel originally free from stress, sudden heating on one surface produces the effects of compressing that surface and of setting up a tensile stress in the other. It is this sensitive surface in which fracture invariably originates.

---

* British Patent, 197381.

* Vortrag in Verein z. Beförd des Gewerbfl., 1892, p. 11.

† Jena Glass, Hovestadt.

Schott developed these methods on a commercial scale, applying them to laboratory glassware, lamp-glasses and gauge-glasses. He stated that boiling flasks did not fracture when heated till aniline boiled violently in them (boiling point of aniline, 184°C.), a jet of cold water at the same time being sprayed upon them. Schott protected his methods* and placed gauge-tubes on the market under such names as "Robax" and "Durax." These tubes could be heated in oil to 230°C. and then immediately plunged into cold water without fracture. The German Reichanstalt issued very favourable reports about them.

Experiments were also carried out in this country upon the same lines with some success. The great disadvantage, however, with glass of this description, is its unreliability, for owing to the highly stressed condition when cold, fracture is liable to occur at any time. For this reason the demand has not been in any way what was at first anticipated.

The process of superposing layers of glass has an important development in the so-called laminated glass, which has been found to offer great resistance to mechanical shock. In an account of some tests carried out upon glass of this nature† it was stated that three thicknesses were used, the middle consisting of plate glass nine-sixteenths of an inch thick and the outer layers of one-eighth inch sheet. Between the outer and inner sheets were placed layers of transparent pyroxylin less than one-quarter inch in thickness. A high velocity rifle bullet fired from a distance of three feet penetrated the outer sheet, making a hole three-eighths of an inch in diameter, but the second and third sheets, although broken, were not penetrated.

In making laminated glass, the following method* has been used for cementing the component sheets. The surfaces are treated with solution composed of gum mastic, pyroxylin or collodion, recinol oil, amyl acetate and alcohol, and the superposed sheets are then subjected to such pressure as will allow the excess solution to escape. The sheets are heated during this operation and upon cooling, the edges are treated with linseed oil and the heating and pressing operations repeated. Finally the edges are treated with a shellac varnish.

The mechanical treatment of glass as a means of promoting thermal endurance has now been practically abandoned and the problem has been attacked from the chemical side, that is, by controlling the co-efficient of expansion, with much greater success. The mechanical strength of a glass, however, is of great importance since it has direct influence upon thermal endurance.

Among the earliest to investigate the tenacity (tensile strength) of glass were Winkelmann and Schott. They used a method employed by Voigt, in which a load was applied to a rod of the glass under examination, the load being increased until rupture occurred. The cross section of the rods was square, ranging from 11 to 19 mm. In all, 17 glasses were tested, each glass being given from two to nine tests. Some of the results are given in Table II below, together with the composition of the glass. The numbers in the first column are those found in Winkelmann and Schott's list of 72 glasses.†

Table II.

Glass No.	Composition Per Cent.									Tenacity in kg/mm².
	SiO_2	B_2O_3	ZnO	PbO	Al_2O_3	BaO	Na_2O	K_2O	CaO	
19 = 5	71.0	14.0	—	—	5.0	—	10.0	—	—	6.95
20	20.0	—	—	80.0	—	—	—	—	—	3.53
25	70.6	—	12.0	—	—	—	17.0	—	—	8.51
26	41.0	—	—	51.7	—	—	—	7.0	—	5.39
28	64.6	2.7	2.0	—	—	10.2	5.0	15.0	—	6.76
29 = 8	67.9	—	5.8	8.1	1.0	—	16.8	—	—	6.79
30 = 10	58.7	—	—	—	—	—	—	33.0	8.0	7.82
32	54.8	—	17.0	—	—	—	—	28.0	—	8.32
3	29.3	—	—	67.5	—	—	—	3.0	—	5.32
5 = 7	73.8	—	5.0	—	3.5	—	10.5	—	7.0	8.35

An attempt was made to express the tenacity as a linear function of the percentages of the constituent oxides by the formula

$$P = a_1x_1 + a_2x_2 + a_3x_3 + \dots ,$$

a_1, a_2, a_3, ... being the percentages of oxides. The values assigned to the various oxides are given in Table III below.

Table III.

SiO_2	0.09	MgO	0.01
B_2O_3	0.065	Al_2O_3	0.05
ZnO	0.15	BaO	0.05
PbO	0.025	Na_2O	0.02
CaO	0.20	K_2O	0.01

---

* German Patent, 61573.

† Mining and Metallurgy, 1921, 169, 50.

* British Patent, 175044.

† Ann. d. Phys. und Chem., 51, 697.

It will be seen that lime has the greatest value, indicating that it exerts a favourable influence on the tenacity, while magnesia is the least favourable in its effect. It was pointed out, however, that there was some doubt as to the values of the two oxides mentioned. The tenacity, calculated by means of the above values, shows an average difference of 8 per cent. when compared with the observed values. Errors in the observations are mainly due to imperfect centering of the rods and to faults present in the surface of the glass. A comparison of the observed and calculated values is made in Table IV.

Table IV.

Glass No.	Tenacity in kg mm^2		a — b
	Observed (a)	Calculated (b)	
19 = 5	6.95	7.75	— 11%
20	3.53	3.80	— 8
25	8.51	8.51	+ 0
26	5.39	5.06	+ 6
28	6.76	7.07	— 5
29 = 8	6.79	7.59	— 12
30 = 10	7.82	7.22	+ 8
32	8.32	7.75	+ 7
33	5.32	4.36	+ 18
35 = 7	8.35	9.19	— 10

Some investigations upon the tenacity of glass were carried out by Littleton*. An attempt was made to eliminate surface effects by setting up a compressive stress in the outer layers so as to resist the applied load. A glass slab was rapidly chilled from a temperature above the annealing point and a rod of square cross section cut from it. This was supported at the ends upon parallel knife-edges and loaded in the middle until rupture occurred. The stresses were measured optically and the determinations indicated an accuracy of 5 per cent. With annealed specimens the accuracy showed a variation up to 40 per cent.

Similar investigations were later carried out by the same author.† To overcome inaccuracy caused by superficial imperfections, strips were used cut from blocks of glass which had been quenched in oil from a temperature above their annealing points. The strips were of rectangular cross section and were so cut that the course of the lines of equal strain was parallel to the surfaces. The specimens were supported upon parallel knife-edges as before and loads applied to the middle. The author showed by means of curves that the maximum tension occurred in a zone near the neutral axis of the bent specimen. It was at this zone that fracture originated and not at the surface.

The case of a borosilicate glass and that of a lead glass were investigated, and it was found that as the initial strain increased, the tensile strength also increased. Specimens of the borosilicate glass possessing high initial stress had a strength of 14.74 kg/mm^2, whereas with annealed specimens the strength was 7.2 kg/mm^2. The lead glass showed a similar difference between stressed and unstressed specimens, the figures being 12.22 and 7.64 kg/mm^2 respectively.

The mechanical strength of glazing glass was the subject of investigations by Williams.* The usual method was employed, a length of glass being supported at its extremes and observations made of the load required to cause rupture, the energy required to cause rupture when the glass was struck a sudden blow and Young's modulus. Some 5,000 specimens were tested which included practically every kind of glass used for glazing purposes.

The dimensions of the specimens were 18 ins. by 2 ins., the knife-edges 16 ins. apart. The load was applied to the centre by means of shot at the rate of 10 lbs. a minute for lighter samples such as ordinary sheet and 15 lbs. a minute for heavier varieties. In the determination of the energy required to cause rupture upon sudden impact, a pendulum was employed with a steel disc tup, 1½ ins. in diameter, $\frac{9}{16}$ of an inch in thickness and 6 ozs. in weight. The specimen was held flat upon iron supports 16 ins. apart. A magnetic release was so devised that the striker made contact with the glass at right angles to the surface, the impact being increased by raising the pendulum to an angle, indicated by a specially graduated dial, equal to an increase of 0.025 ft. — lb. until rupture occurred. The impact modulus was calculated from the formula

$$S = 18 \frac{E}{AL} W,$$

where E is Young's modulus, A and L the area of the cross section and length of the sample respectively and W the energy in ft.—lb. required to cause rupture.

From the data obtained, the author prepared values for the modulus of rupture which might be considered as a safe working strength for different varieties of glass. These are given in Table V below.

Table V.

	lb. per sq. in.
Ribbed, rolled sheet or wire glass ..	5,300
29 oz., 34 oz., and 39 oz. or $\frac{3}{16}$ in. clear sheet glass and ¼ in. plate	6,500
Single or double strength window glass and 26 oz. clear sheet glass	7,000
Corrugated wire glass (¾ in. deep)	9,500
Corrugated wire glass (1 in. deep)	13,500

It will be seen that ribbed glass has a comparatively low value, but this is owing to the measurements of the thickness of the sheet being determined from the top of the rib. Sheet glass was found to be superior to either rough cast plate or polished plate.

---

* Phys. Rev. 1920, 15, 521.

† Phys. Rev. 1923, 22, 510.

* J. Amer. Cer. Soc., 1923, 6, 980.

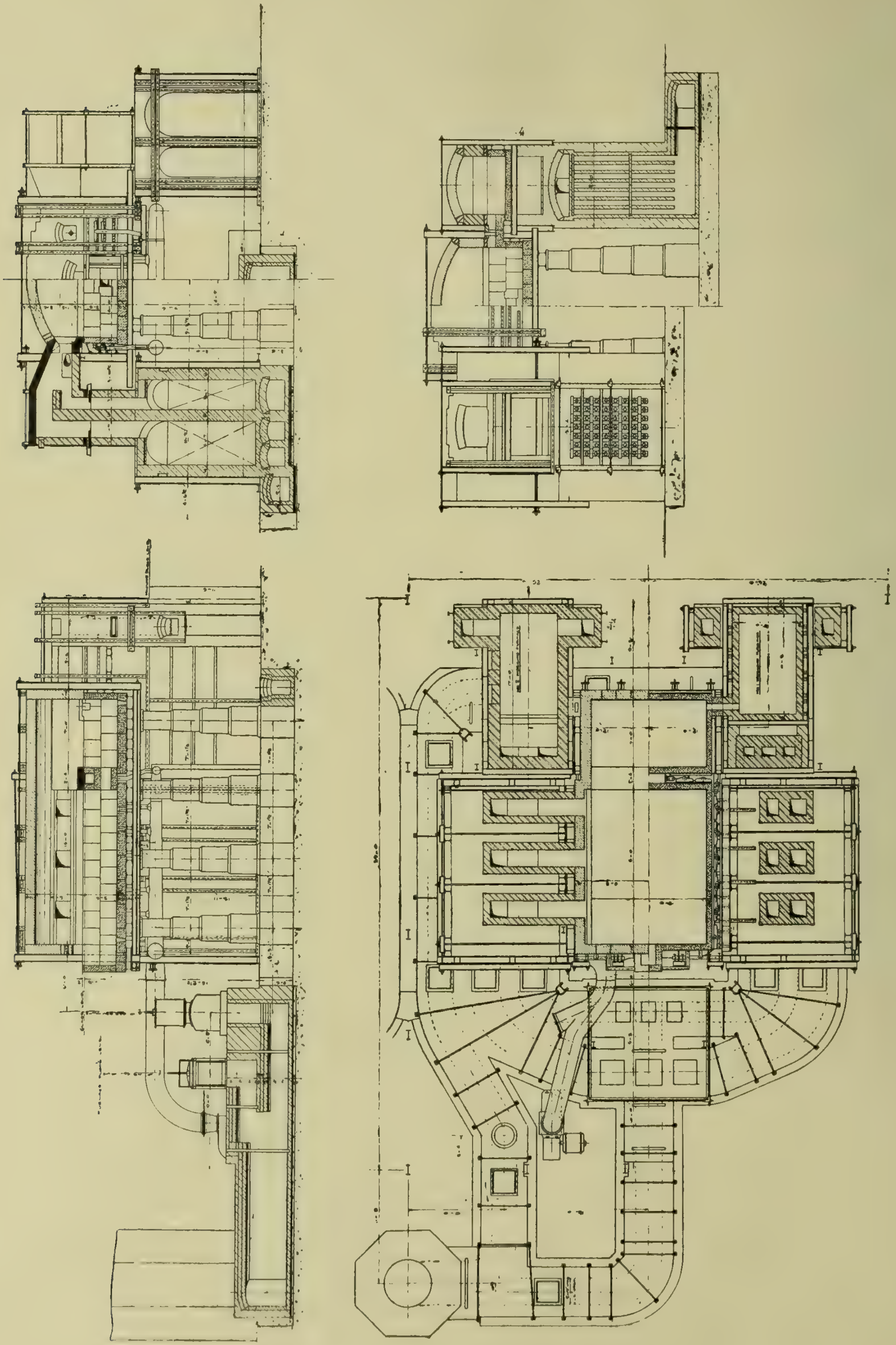


Fig. 1.
General Arrangement and Lay-out of Furnaces.

The Bulb Making Plant of the General Electric Company at Wembley.

In our issue for February, 1924, we described the Danner Tube making machines and equipment as installed by the G.E.C. at their Wembley glass works, and it was then mentioned, in connection with the batch mixing plant, that this plant had been designed in order that at some future date it would be also capable of handling the mixing of materials for the manufacture of bulbs. Since that date the Company has completed the erection of a bulb making plant, incorporating two 24 arm Westlake machines, the new plant being put into operation at the beginning of March this year.

In designing this new works, great attention has been paid to the probability of it being necessary to increase the productive capacity at an early date, so that the present installation of furnaces and machines forms what may be termed the first unit. The disposition of the gas producers, batch mixing and conveying plant, warehouse, etc., is such that additional productive units can be installed as required without interfering with the first unit or sacrificing efficiency in any way.

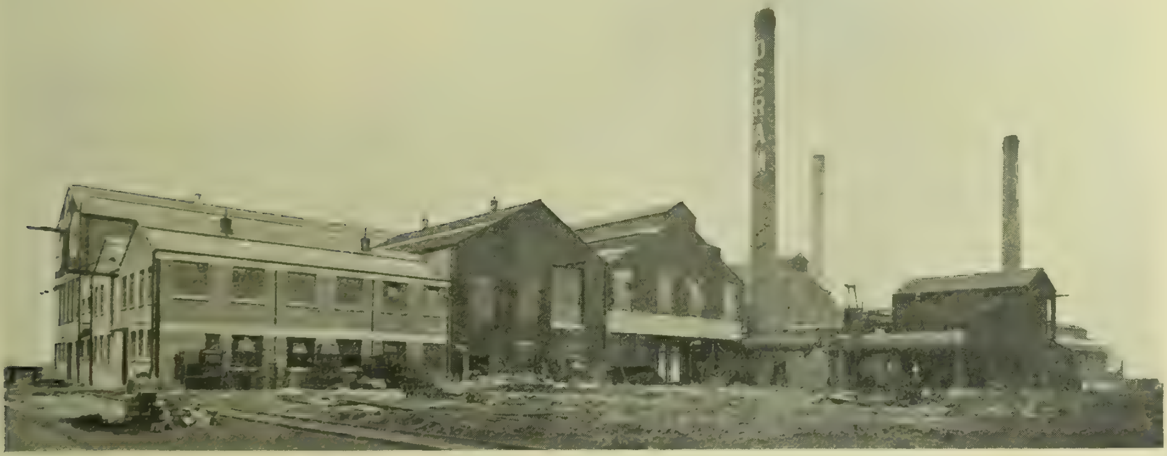


Fig. 2.
General View of Works.

Before describing the actual plant it might be mentioned that the bulbs are made of a soda lime glass having the following approximate analysis, whereas of course, the tubing is made from a lead glass.

Approximate Analysis of Bulb Glass.

Silica	73.0	per cent.
Sod. Oxide	17.5	,,
Calcium Oxide ..	5.5	,,
Alumina	1.0	,,
Magnesium Oxide ..	3.0	,,
	100.0	per cent.

The furnaces consist of one melting tank having the following inside dimensions : melting end 16′ 0″ × 12′ 0″ bridge 2′ 4″, refining end 7′ 0″ × 12′ 0″, metal depth 3′ 3″, which supplies the glass to two "working" furnaces. The disposition of these three furnaces can be seen from Fig. 1, the capacity of the melting tank being 60 tons, and each of the working tanks 10 tons, giving a total of 80 tons of glass. The gas for the operation of the melting tank (which is of the ordinary regenerative type) is supplied by two 8′ 6″ dia. fixed grate producers fitted with Chapman Agitators, though only one producer is in operation at a time. The two working tanks are totally independent of the melting tank. They are fitted with Stein patented recuperators (see Fig. 5) and are fired with gas supplied in each case by independent, built-in, producers. This arrangement can also be seen in Fig. 1.

The depth of metal in the working tanks is 18 inches, but it should be noted that the metal line or level is the same throughout, from the dog-house in the melting tank right through to the gathering boot for the machines. We mention this point specially because it is sometimes thought that the glass flows down through a spout in a similar manner to that in Owens machine installations.

In connection with the melting furnace it is of interest to note that each gas and air uptake is fitted with a proper built-in damper (these can be seen in Figs. 1 and 8). This feature is not only of material assistance in controlling the temperature distribution in the tank, but is also appreciated when hot repairs become necessary.

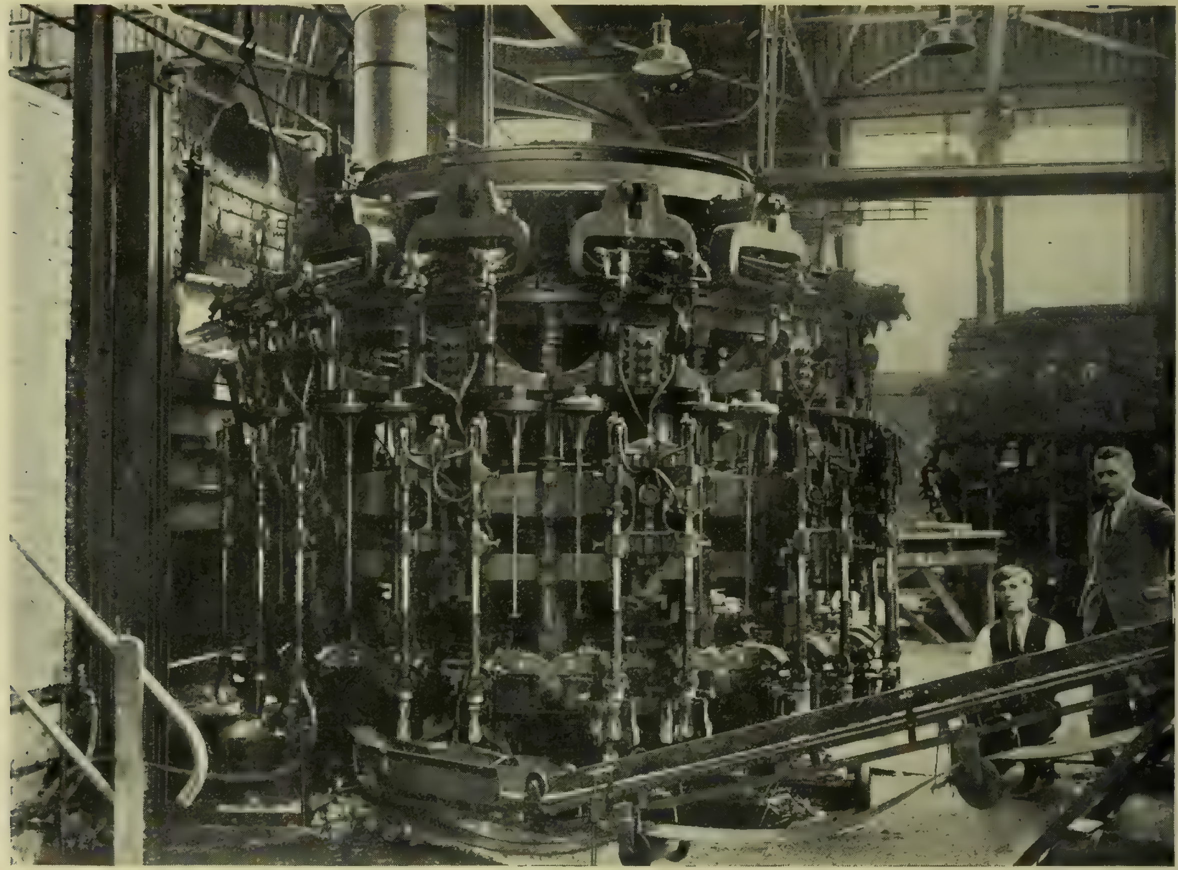


Fig. 3.
Westlake Machine. Note gathering arms in furnace and bulbs ready for delivery from machine.

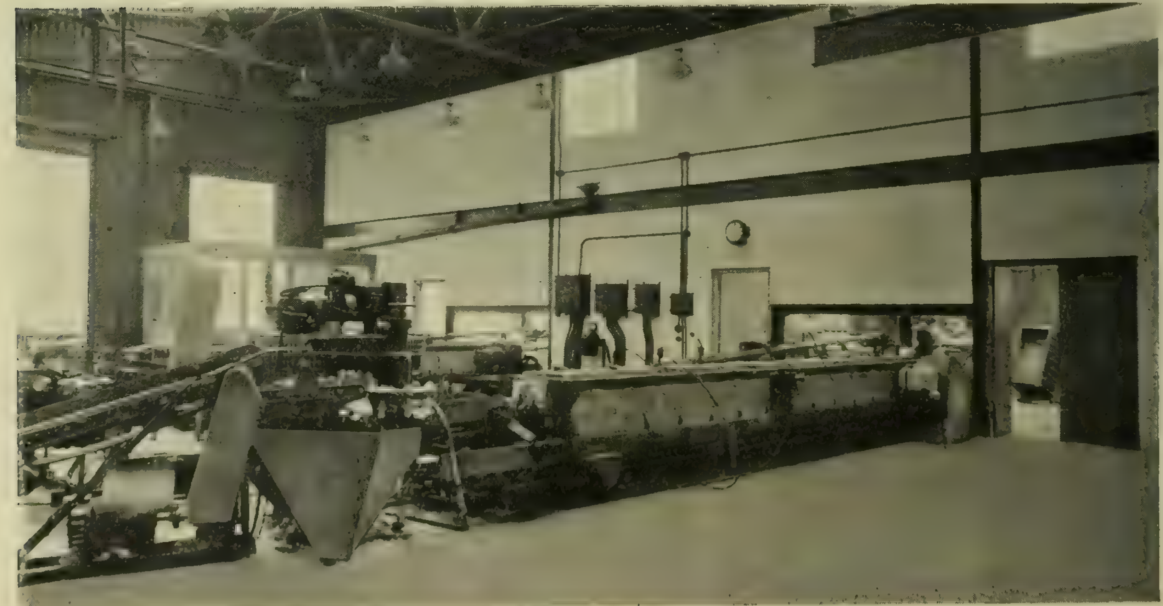


Fig. 4.
General view of "burning-off" machine, lehr, etc.

Before leaving the furnaces mention might be made of the cooling arrangements for the tank (Fig. 1). Air is supplied at a pressure of about 1″ W.G., the fan having a capacity of 12,000 cu. ft. per minute being driven by a 8 h.p. motor. A somewhat unique feature of the installation is that there is an air space under the flues and regenerators, etc., the object being to prevent as far as is possible, heat reaching the clay upon which the works are built and drying it out, with the resulting shrinkage and possible collapse of foundations, etc.

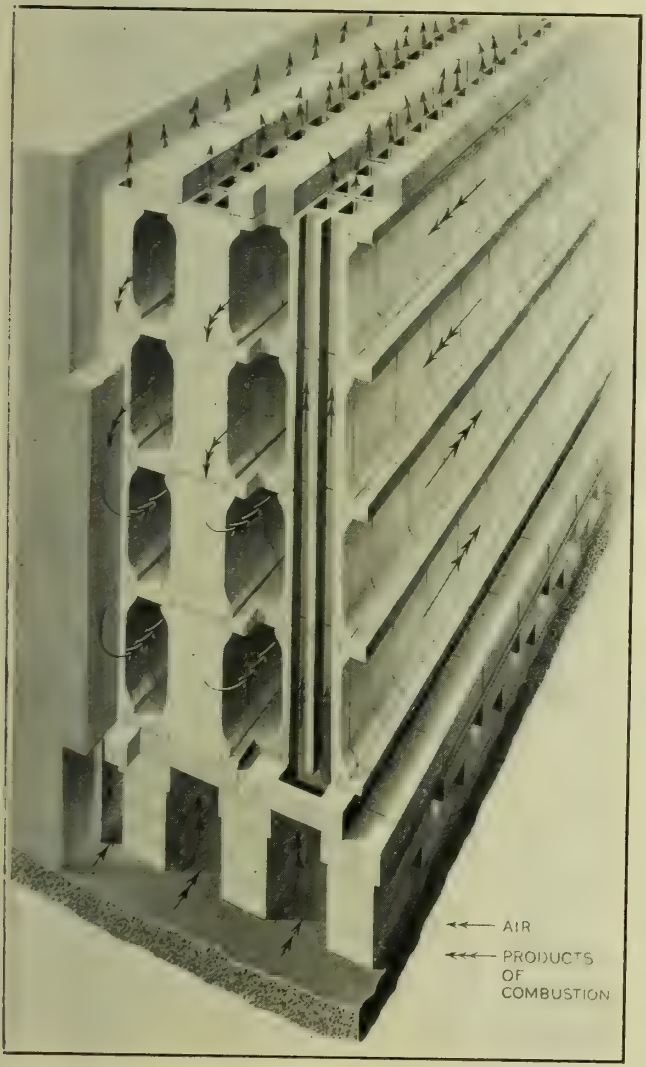


Fig. 5.
Diagrammatic View of Stein Recuperator.

The furnaces are, of course, fitted with pyrometers, whilst an electric CO_2 recorder has been installed to record the CO_2 content of the waste gases as a check on combustion efficiency.

The general arrangement of the furnaces which were designed in collaboration with the G.E.C. staff, and built by Messrs. Stein & Atkinson, will be seen from Figs. 1 and 8.

Coming now to the bulb-making machines, the principles upon which they operate may be briefly stated as resembling those of the Owens machines for the production of bottles, in that the arms or heads radiate from and rotate round a central column, the moulds take up their supply of molten glass from the working tank by suction and the parison thus formed is eventually transferred to a finishing mould, where it is finally blown to shape.

The construction of the two types of machines and the methods and means adopted to achieve the desired results, are of course, greatly different, but as just mentioned the principles are closely allied.

The Westlake machines at Wembley have 12 heads, each head mounting two arms or moulds, as will be seen from Fig. 3, so that the output is 24 bulbs per revolution of the machine.

The parison moulds are mounted near the top of the machine and are carried at the ends of gathering arms set at an angle with the horizontal. As the machine rotates and the arms come in front of the working opening, they move outwards and into the working tank, and due to the inclination just mentioned, the bottom of the parisons come into contact with the molten metal, the vacuum valves open and the moulds obtain their supply of glass (the surplus being cut off by means of an oscillating knife fitted to each arm) and the arms again withdraw, the whole operation taking about 1.5 seconds.

When the gathering arms with their parison moulds and their charges of glass are withdrawn, the moulds are opened and the glass is transferred to the neck or ring moulds carried at the ends of the vertical arms to be seen in Fig. 3, which, however, at the time they receive the glass have been rotated through 180 degrees round a central trunnion, so that the ring moulds—which can be clearly seen holding the blown bulbs at bottom of Fig. 3—come immediately under and close to, the parison moulds. These rotatable arms are hollow and are also provided with a plunger which pierces the glass in the ring mould and is then withdrawn in order that compressed air may be admitted for blowing. It will thus be seen that the purpose of the gathering arms and parison moulds is to get the requisite amount of glass from the furnace and transfer it to the blowing arms.

When this transfer operation is completed the process of blowing commences. Air at about 1½ lbs. per sq. inch is admitted in puffs, whilst at the same time the blowing arm is rotated about its longitudinal axis. The correct determination of the duration and intensity of this "puffing" phase is vital to successful operation, as it may be said that at this point the bulb is made or marred.

As the air is admitted, the embryo bulb begins to expand and the blowing arms, still rotating about their own axis, are also once more rotated through 180° about the central trunnion until they again assume the position shown in Fig. 3.

The glass is now hanging vertically and is allowed to stretch a little, during which time the blow or finishing moulds swing into position and finally close round the suspended glass. Air at about 0.5 lbs. per sq. in. pressure is then admitted and the bulbs blown to shape. The finishing moulds then open leaving the bulbs suspended from the ring moulds (see lower portion of Fig. 3) which

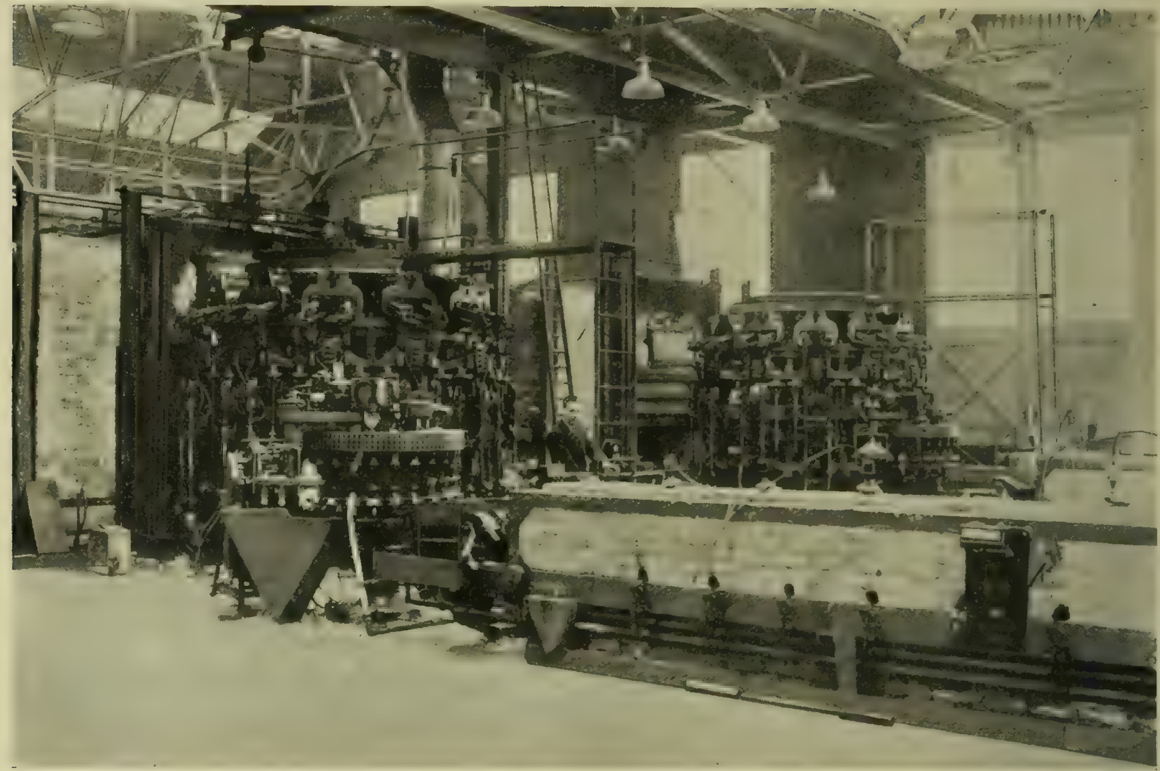


Fig. 6.
View showing bulb machines, burning-off machines and lehr.

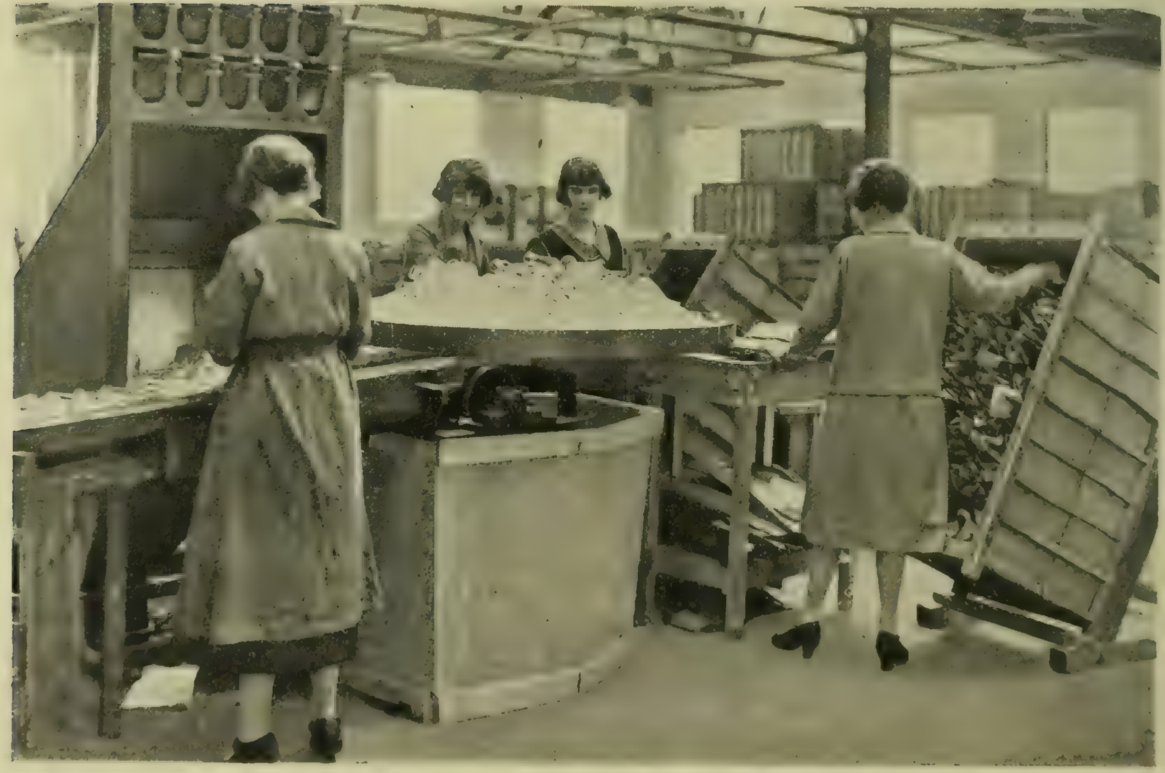


Fig. 7.
Inspection and Packing.

finally open and drop the bulbs onto the conveyor which carries them to the "burning-off" machine. As the machine continues to rotate the blow moulds which, of course, are "pasted,"are dipped into and out of a water trough, to be ready to receive their next charge.

In connection with the parison moulds, owing to their light section it is of course impossible to allow them to plunge into the molten metal; they must just touch the surface. The result is that it is absolutely essential to maintain a constant level of metal in the working tank and as this level is the same as that at the dog house in the melting tank, it follows that this maintenance of level is in the hands of the founder. A tolerance of 1/32 inch only is allowed, and therefore the founder must be provided with some means of knowing when a variation occurs. To effect this, a fireclay float is placed in a boot the metal level in which varies with that of the furnace. When this level rises or falls the float also rises and falls, closing the contacts of an electric bell circuit. This bell continues to ring as long as the level is high or low, and the method has been found to be very effective.

As it leaves the machine and falls on to the conveyor, the ring or cap of glass by which it was held in the blowing arm is still attached to the bulb and having fulfilled its purpose, it has to be cut off before the bulb is serviceable. This operation is performed in the rotary "burning-off" machine seen to the left of Fig. 4. The machine can also be seen in front of the bulb machine in Fig. 6. In this latter photograph the glass cup or neck to be removed is clearly shown on the two bulbs immediately over the sheet iron funnel at the left.

As the bulbs are delivered by the conveyor they fall into slots in a star wheel feeder, the speed of which is synchronised with that of the burning-off machine. The bulbs are then picked up by individual holders which rotate about a vertical axis. Whilst rotating in this manner a series of small high pressure gas jets impinge on the bulb at the point where it is desired to sever the cap. The heating action of these jets is extremely localised, with the result that the glass is melted at that point and the cap falls off, whilst the edge that is left on the bulb is fused and rounded as distinct from the sharp edge left by diamond cutting. In addition to the localised cutting jets the bulb is also subjected to a general heating to avoid breakage.

After this cracking off is completed the bulb then falls on to the lehr belt and is immediately passed into the lehr for annealing. The lehr which is simply a tunnel through which the chain or belt passes, is fired from below with town's gas and is not of the muffle type. These gas burners can be clearly seen in Figs. 4 and 6. The lehr is about 20 feet long and 18 inches wide and is provided with six thermo couples, the temperature drop being from 600° C. at the hot end to 170° C. at the cold, the time the bulbs take to pass through being approximately 1½ minutes.

Leaving the lehr the annealed bulbs are then carried by another conveyor to the inspection table as shown in Fig. 7. Here they are carefully examined before being packed for despatch to the lamp works and a rather unique though simple device is used to classify the various defects. This can be seen in Fig. 7 imme-

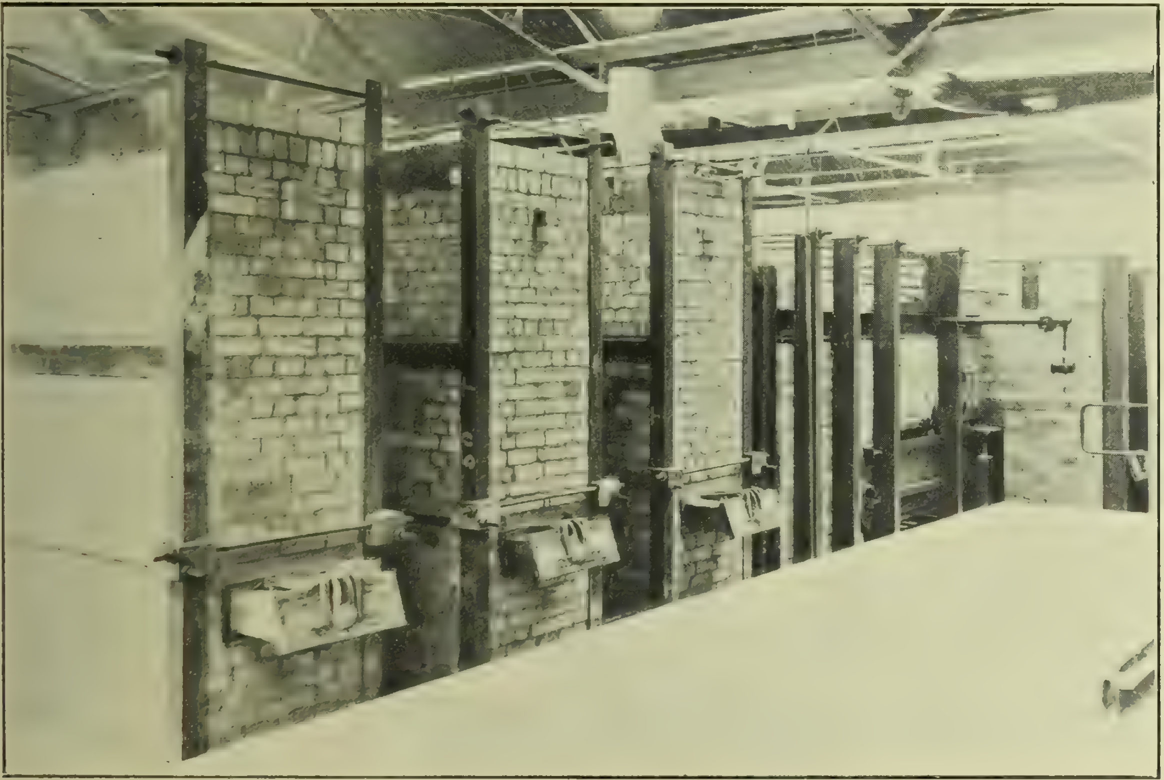


Fig. 8.
View showing ports of melting Tank, with one working furnace on right.

diately above the head of the girl examiner. As will be noticed, there are 10 small pigeon holes or openings each fitted with a swing flap or door. Attached to each of these doors is a small counter of the Veeder type. All bulbs having the same defect are pushed through the same door and as each hole is used for a separate defect, by reading the counters periodically, a complete account is obtained of the total rejections and at the same time an analysis of the reasons for rejection.

It will be obvious, therefore, that this device enables the causes of the defects to be immediately localised and we were informed that it had proved extremely valuable in improving production efficiency.

Whilst on this subject we might mention that each hour the operating results for the previous hour are written on a large board (to be seen in Fig. 4) alongside each machine, so that the operators and those in charge know exactly what is taking place. This is a feature which could be followed with advantage by many other glass works.

After inspection the bulbs are packed in paper in the crates shown in Fig. 7, and are then ready for despatch to the Osram lamp works, and it is interesting to note that the time which has elapsed since the glass was gathered from the working pot until the bulb has been inspected and is ready for packing is only five minutes, whilst with both machines in operation the daily output is from 120-130,000 bulbs.

As will be realised the successful operation of machines of this nature necessitates excellent upkeep and maintenance, consequently the fitting and machine shop equipment is of the best and latest type. A works laboratory is also equipped, but owing to the proximity of the excellent Research Laboratories of the G.E.C. only routine work is carried out at the factory.

The plant is electrically driven throughout, with motors supplied by the Witton Works of the Company, and a central power house contains the necessary converting plant for supplying the direct current for the operation of those machines requiring speed variation. All the air compressors, vacuum pumps, blowers and gas boosters are also housed in the same room, thus centralising control.

A feature which the majority of other glass works could advantageously copy, is the lighting. The scheme was prepared by the Illuminating Department of the G.E.C., and the results are such that at night the many rooms are better illuminated than during the day.

In conclusion we should like to express our appreciation and thanks to the General Electric Company for allowing us to publish this description and for their courtesy in loaning some of the photographs, also to Messrs. Stein & Atkinson, who have kindly loaned us the drawings for Fig. 1 and 5 and the photograph of the furnace.

VISIT TO OSRAM G.E.C. WORKS AND LABORATORIES.

On the day following the Annual Dinner (see pages 286 and 287) Members of the Society visited the Osram G.E.C. Glassworks described in this issue, and also the G.E.C. Research Laboratories. After an inspection of the works and laboratories, the members were the guests of the Directors of the G.E.C. for luncheon.

In the afternoon a meeting was held in the Library, at which several papers were read and discussed.

The first was entitled "Opal Glass," by Mr. J. W. Ryde, being a communication from the G.E.C. research laboratories. The author stated that a number of commercial and experimental opal and opalescent glasses had been examined by the X-ray method in order to determine the nature of the opacifying material which separated out. Contrary to all existing theories it was found that the opacity of fluoride glasses was due to the separation of calcium fluoride or sodium fluoride, or a mixture of both.

"The Electrical Conductivity of Glass at High Temperatures" was the title of a paper read by Mr. F. F. S. Bryson, in which he gave the results of some experiments he had made at temperatures above the softening points of the glasses. It was found that the substitution of silica by soda in a simple silica soda glass caused a considerable increase in conductivity. A less marked increase in conductivity was obtained when magnesia was substituted for silica. The substitution of alumina for soda or silica resulted in a diminution of the conductivity. The relation between the viscosity of a glass and its electrical conductivity was discussed and illustrated by viscosity measurements of glasses.

Professor Turner read a paper, "The Influence of Moisture on the Rate of Melting and on the Properties of Soda-Lime-Silica Glasses," by Miss E. M. Firth, Messrs. F. W. Hodkin, M. Parkin, and Professor Turner. He stated that, on the whole, the effect of moisture on the ultimate composition of the glass obtained was practically negligible.

Maintain

Efficiency

in the hot weather

IN sheet glass and bottle works, etc., where intense heat handicaps the workers, a system of STURTEVANT COLD AIR DOUCHE has proved immensely valuable. It delivers a supply of cool fresh air at those points where the men are working under trying conditions, with consequent improvement in output both as regards quantity and quality.

If you have any ventilating problems, large or small, write to Dept. G.L.31 for particulars and our booklet G.L.1241 which will be sent to you without further obligation.

STURTEVANT
ENGINEERING
Co. LTD.
149 QUEEN VICTORIA ST. LONDON E.C.4.

Refractories for the Glass Industry.[*]

By W. J. REES, B.Sc., Tech., F.I.C. (Lecturer in Refractories, University of Sheffield.)

(Continued.)

Silica Refractories.

For those portions of the structure of both pot and tank furnaces which are not in direct contact with the melting batch or molten glass—such, for example, as the crown, upper part of the walls and ports of tank-furnaces; the crown, upper walls and pillars of pot-furnaces—silica bricks or blocks are almost invariably used. The temperature and general conditions in the above mentioned situations are such as to be favourable to a long life for silica bricks of good quality. The most important difference in the behaviour on continued use at glassmaking temperatures of fireclay bricks and silica bricks is that the former contract whilst the latter expand. This freedom of silica bricks from contraction on continuous exposure to high temperatures is an important factor, as in crowns and pillars, in particular, absence of shrinkage is desirable in order to retain the mechanical stability of the structure. A further advantage is obtained from the use of silica bricks in the crowns of tank-furnaces or open-pot furnaces in that "droppers" formed by the action of alkaline dusts, etc., on the bricks are readily soluble in the glass and consequently do not form "stones." It should also be noted that the skin-melts which are formed on the surface of good quality silica bricks are of high viscosity because of the high effective concentration of silica and a protective layer is consequently formed which retards the wear or corrosion of the bricks. Highly converted, close-textured silica bricks also possess to a high degree the reflecting power characteristic of molten silica; heat-loss through the brickwork is thus diminished and the heat-radiation on the bath of metal increased in intensity.

"Semi-silica" bricks are also occasionally used in positions in which constancy of volume is of importance. Bricks of this type are sometimes unfortunately described as "ganister bricks"; they are made from mixtures of fireclay and crushed silica rock in such proportions that, on use at moderately high temperatures, the contraction of the fireclay is approximately neutralised by the expansion of the silica rock. Their properties will be dealt with later in one of the subsequent articles.

Chemical Composition.

The author in investigating the characteristics of silica bricks has made chemical analyses of all the brands of these bricks which are manufactured in North and South Wales, the Sheffield District, the North of England and Scotland.[†][‡] The chemical composition was found to vary between the following limits :—

Silica	93.02	to	96.73	per cent.
Titanic Oxide	0.09	,,	0.41	,,
Alumina	0.64	,,	2.18	,,
Lime	0.71	,,	2.86	,,
Magnesia	0.09	,,	0.46	per cent.
Ferric Oxide	0.39	,,	2.36	,,
Alkalies (as K_2O)	0.36	,,	1.02	,,

The observations which were made on the performance and durability of these bricks in various types of industrial furnaces suggest the following specification of the chemical composition of silica bricks for use in glass-melting furnaces :—

Silica	Not less than 94.0 per cent.
Lime	Not more than 2.2 per cent.
Magnesia	Not more than 0.4 per cent. if lime is less than 1.8 per cent. Not more than 0.25 per cent. if lime is more than 2.0 per cent.
Alumina	Not more than 1.5 per cent. unless lime and magnesia are low.
Ferric Oxide	Not more than 1.2 per cent.
Alkalies	Not more than 1.0 per cent.

The effect of small proportions of titanic oxide on the durability of silica bricks in glass-melting furnaces appears to be negligible; the addition of 1 per cent. of finely ground rutile to a silica brick mixture had no effect on the refractoriness of the brick. The proportion of added lime required to produce a mechanically strong brick necessarily varies to some extent with the character of the silica rock from which the bricks are made, the proportion and character of the impurities present, and the grading of the brick. With bricks of average grading, increase of lime beyond 2 per cent. causes a progressive reduction in refractoriness and tends to make the bricks brittle and increase their spalling tendency. In the case of bricks made from silica rocks of a high degree of purity, up to 3 per cent. of lime is permissible but such bricks are not so satisfactory in glass furnaces as those which contain sufficient impurities to ensure adequate bonding with 1.5 to 2.0 per cent. of lime.

A content of ferric oxide up to 3 or 4 per cent. has little or no effect on the refractoriness of the bricks so long as they are used in an oxidising atmosphere, but if the bricks are used under reducing conditions a marked reduction in refractoriness is observed when its ferric oxide content exceeds 1.5 per cent. It has been shown [*]by W. Hugill and the author that the presence of ferric oxide in a silica brick definitely increases the rate of quartz inversion and toughens the brick, but for tank-furnaces or open-pot furnaces in which white glass is melted, it is not desirable that the iron oxide in the silica bricks should exceed 1.2 per cent. The author has at times found it necessary to emphasise the point that the colour of silica bricks is not a criterion of their quality. The pale colour of normal lime-bonded bricks is primarily due to the "bleaching" effect of the lime—colourless lime-iron or lime-alumina-iron compounds being apparently formed—so that increasing the lime content of the brick will make it lighter in colour, but

---

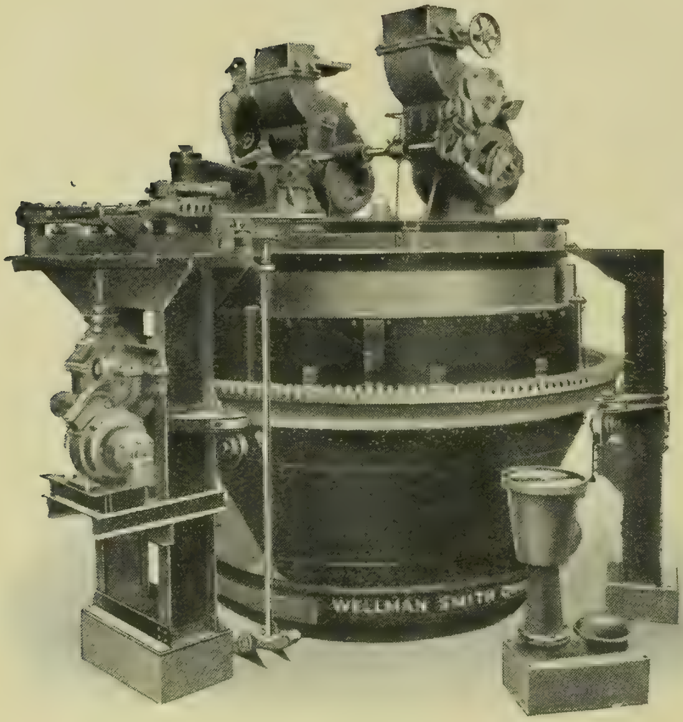
[*] Copyright Reserved.

[†] Trans. Ceram. Soc. 24, 66, 1925.

[‡] Representative samples of American, German and French manufacture were also examined.

[*] J. Soc. Chem. Ind., 1925, B502.

WELLMAN AUTOMATIC GAS MACHINES



These machines have proved to be of the greatest value in Glass Works.

One Glass Works after making exhaustive comparative tests has installed a total of

14 Wellman Producers.

The high efficiency and speed of working is due to the special features described in our booklet for which every Glass Works Manager and Engineer should write.

No. 10 TO GASIFY UP TO 4,000-lbs. COAL PER HOUR.
No. 8 TO GASIFY UP TO 2,600-lbs. COAL PER HOUR.

THE WELLMAN SMITH OWEN ENG. CORP., LTD.

36 - 38, KINGSWAY, LONDON, W.C.2.
WORKS :: :: DARLASTON, S. STAFFS.

Telephones: HOLBORN 2588/9. *Telegrams:* "PRINCIPIUM, WESTCENT, LONDON."

will at the same time lower its refractory value. Conversely, reducing the lime content will produce a darker-coloured brick and an increase in refractory value. The temperature of firing (particularly the duration of the high temperature "soaking" period), the atmosphere of the kiln during the final stages of burning, and the texture of the brick also affect the colour. In the author's experience, pale-coloured bricks have been found to be better, equal to, or poorer in their physical properties than dark-coloured bricks; it being possible to sum up a large number of observations in the statement that there is no necessary connection between the colour and quality of silica bricks.

The presence of 0.5 to 1.5 per cent. of alumina in silica bricks is beneficial, as its interaction with lime and silica produces a melt which accelerates the conversion of the quartz and tends to the production of a crystalline matrix which increases the mechanical strength of the bricks both at normal and high temperatures. More than 1.5 per cent. of alumina is undesirable, especially if the silica content is lower than 95.5 per cent., as it will reduce the refractoriness of the bricks.

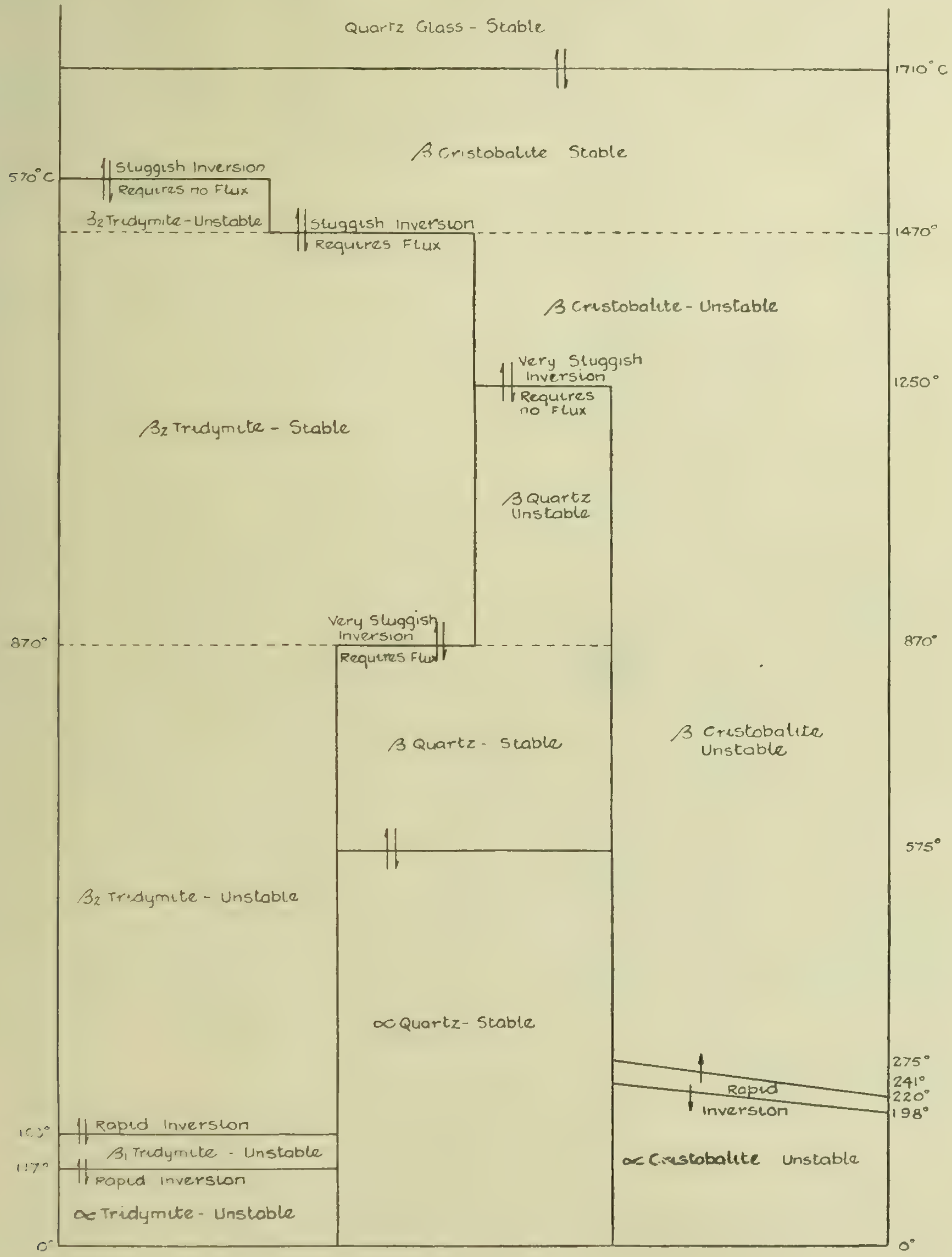
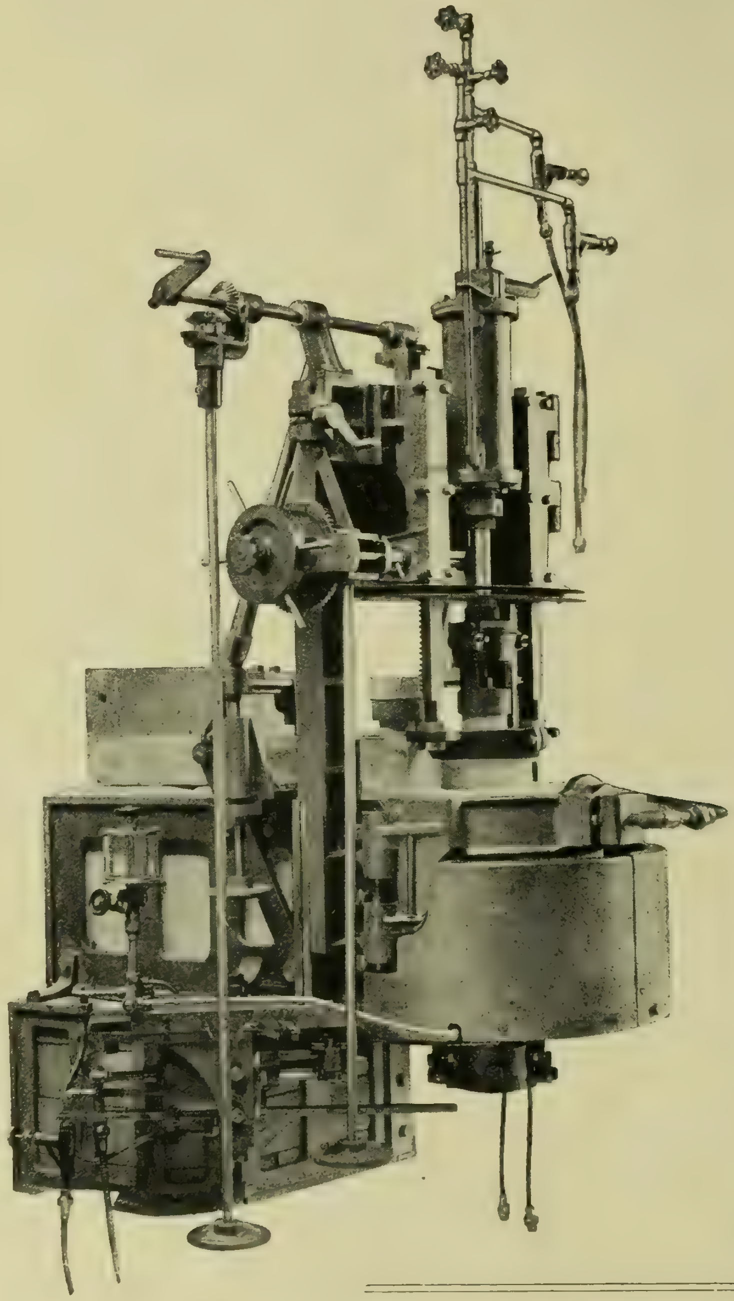


Fig. 1.

The sum of the alkalies present should not exceed 1.0 per cent. even in bricks of high silica content, as they cause premature softening of the matrix and will reduce the mechanical strength at high temperatures

The "RANKIN" Automatic Glass Feeder.



RESULTS JUSTIFY CLAIMS.

Claims without justification are futile.

The need for automatic production is admitted by every glass manufacturer. The question is—what mechanism can be installed with the assurance of the best results?

The "RANKIN" record is unrivalled in the Glass Feeder world. Its history is unique. In no instance has a "RANKIN" installation once installed been superseded. On the contrary, wherever it has been adopted, further installations have followed.

The latest proof of this claim is a repeat order for **TWELVE FEEDERS** from a Glass Manufacturing Company, who originally put in one Feeder for comparison with other similar devices. This we believe to be

THE LARGEST INDIVIDUAL ORDER EVER PLACED FOR AUTOMATIC FEEDERS

and represents a great triumph for an All-British Built Feeder.

The mechanism, material and finish are of the highest possible quality. The "RANKIN" Feeder is built for service and will outlast all others.

Demonstrations of the RANKIN AUTOMATIC GLASS FEEDER will be arranged by appointment.

For Illustrations, Descriptive details and terms apply to :

THE RANKIN AUTOMATIC GLASS FEEDER CO.,

1, CHARTERHOUSE STREET, LONDON, E.C.1.

Telegrams : Natiglaso, London. *Telephone Nos. :* Holborn, 140 and 141.

(refractoriness under load) owing to the lower viscosity of alkali-carrying melts.

So far as chemical composition is concerned, a silica brick may be approximately evaluated by heating a carefully prepared, impalpably ground sample with hydrofluoric and sulphuric acids in a platinum basin and weighing the sulphates of the basic oxides after the volatilisation of the silica and the excess of the acids. The evaporation should be carried out gently on a sand bath until acid fumes cease to be evolved and the excess acid finally eliminated by gentle heating at a very dull-red heat. Although the relative fluxing effect of the bases which are commonly present is different, it can be assumed for practical purposes that if the weight of sulphates does not exceed 15 per cent. of the weight of pulverised brick taken, the chemical composition of the brick will be within the suggested limits.

Mineralogical Composition.

In a silica brick the coarser fragments of crystalline silica are set in a matrix containing the finer particles of silica together with lime, lime-alumina, lime-iron, etc., silicates; this matrix is often somewhat glassy in character. The matrix consequently varies somewhat in character and proportion with variations in the proportion of "fines" produced during the crushing and grinding of the rock. During the burning of the bricks in the kiln, the smaller grains of quartz are converted to cristobalite or tridymite partly by direct inversion and partly by solution in, and precipitation from, the molten silicates. The coarser fragments of quartz will only be completely inverted to cristobalite and tridymite when the bricks have been "soaked" in the kiln for some time at a temperature above 1450° C. Bricks of fine texture are therefore more readily inverted than those containing coarse fragments. The cristobalite formed in the matrix gradually changes to tridymite when the temperature is maintained at 1450°-1500° C., the tridymite crystals gradually growing as the period of maintenance in that temperature range is prolonged. The conversion of "dry" quartz to tridymite does not take place directly, but cristobalite is formed as an unstable intermediate form and it is, therefore, exceptional to find tridymite in the coarser fragments of the brick unless it is as a fringe. The changes which occur in the various crystalline forms of silica are illustrated in Fig. 1. In well-burned silica bricks the mineralogical constitution is found to vary within the following limits:—

Quartz 5 to 25 per cent.
Tridymite 10 to 45 per cent.
Cristobalite 50 to 75 per cent.

So far as the permanent expansion of the bricks during use is concerned, the proportion of quartz is the important factor. This can be estimated by the microscopic examination of a transparent thin section of the brick, but much more readily by a determination of the true specific gravity (or powder density) of the brick. The specific gravity of quartz is 2.65, of tridymite 2.27, and of cristobalite 2.33, so that the nearer the powder density of the brick is to 2.30, the lower will be its content of quartz. The author has made a large number of observations of the connection between the powder

SILLIMANITE

a neutral refractory material having a definite fusing temperature above 3270°F (1800°C).

The December issue of GLASS reported the following expert opinions expressed in papers or discussion at the Leeds Meeting of the SOCIETY OF GLASS TECHNOLOGY:—

Mr. H. H. Houldsworth (of the Fuel Department, Leeds University).

"Experiments made on commercial sillimanite bricks showed that they exhibit very little permanent change in dimensions on heating, their refractoriness is high, and they offer great resistance to attack by soda-lime-silica glass."

Mr. F. G. Clark (of Messrs. Beatson, Clark & Co., Ltd., Sheffield).

"I can testify to the particular resistance to attack of a mixture of about 66⅔ per cent. sillimanite, from experimental data obtained at my works."

Professor W. E. S. Turner (of the Department of Glass Technology, Sheffield University).

"Glass manufacturers seemed to be more keenly interested in the resistance offered to corrosion by glass, by a refractory material, than its ability to withstand unusually high temperatures."

Mr. W. J. Rees (of the Refractories Department, Sheffield University).

"Sillimanite mixtures containing not less than 60% sillimanite were already justifying themselves for purposes where a highly refractory, resistant material was necessary."

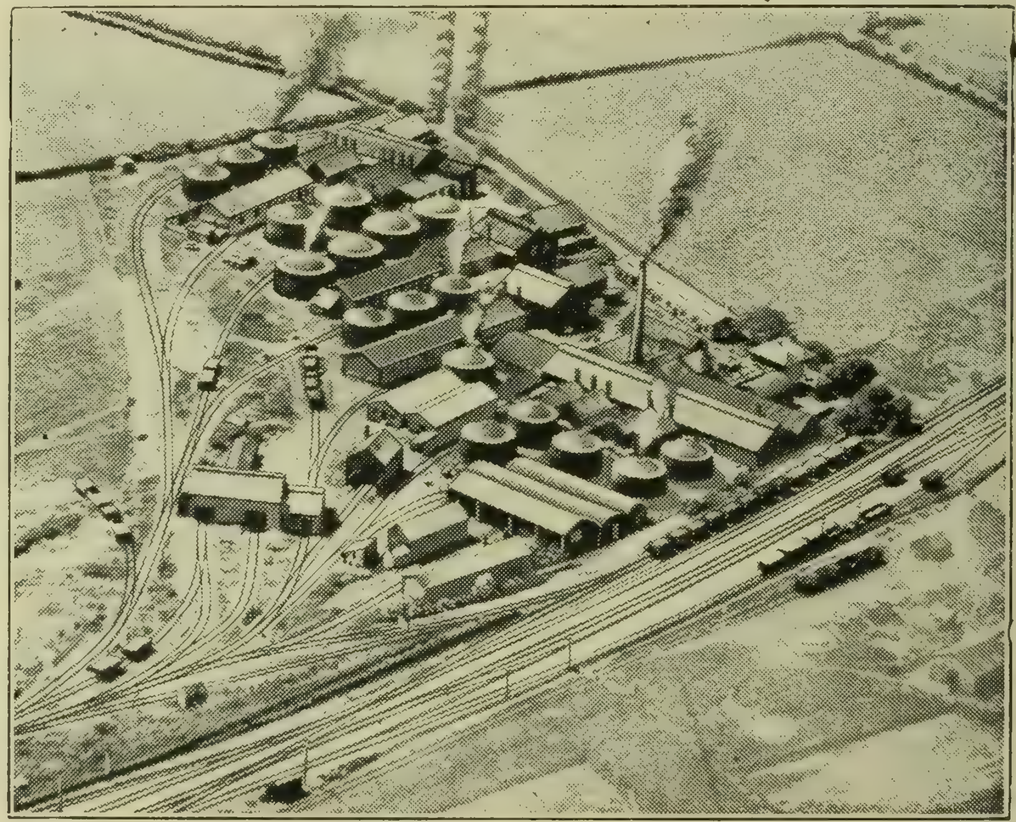
P.B. Sillimanite is now available in the raw state, crushed and graded, and in the form of Bricks, Blocks, Shapes, etc.

The P.B. SILLIMANITE
COMPANY, LIMITED,
Sole Agents: PAWLE AND BRELICK.
791, SALISBURY HOUSE,
LONDON WALL, LONDON, E.C.2.
Telephone Number - London Wall 4825.

THE MOST DURABLE **BRICK**
MADE FOR **GLASS FURNACES.**

STEPHENS SILICA "C"

EXTREMELY REFRACTORY, TOUGH AND DURABLE.



VIEW TAKEN FROM AN AEROPLANE.

Kiln Capacity 1½ Million Bricks. Works Cover over 9 Acres.

SUPER SILICA CEMENT for setting SILICA BRICK.

Used by most of the principal GLASS WORKS.

STEPHENS & CO., KIDWELLY.

density of silica bricks and their after-expansion as determined by the standard after-expansion test. (In this test a portion of a brick approximately 3 inches in length and 1 to 2 inches in width and depth is slowly heated to 1410° C. and maintained at that temperature for two hours.) The data for 40 of these bricks are given in the graph Fig. 2 below. An examination of this graph indicates that for bricks of normal lime content and of fine or medium texture there is a sufficiently close relation for practical purposes between the true specific gravity, the degree or extent of quartz conversion, and the after-expansion as measured in the standard test. The samples on the right of the diagram which deviate from the graph are coarse-textured bricks; on doubling the period of heating at 1410° C. the after-expansion of these samples increased and brought it into normal relationship with the true specific gravity of the brick. For coarse-textured bricks, therefore, the time of heating specified in the standard test is insufficient and should be doubled.

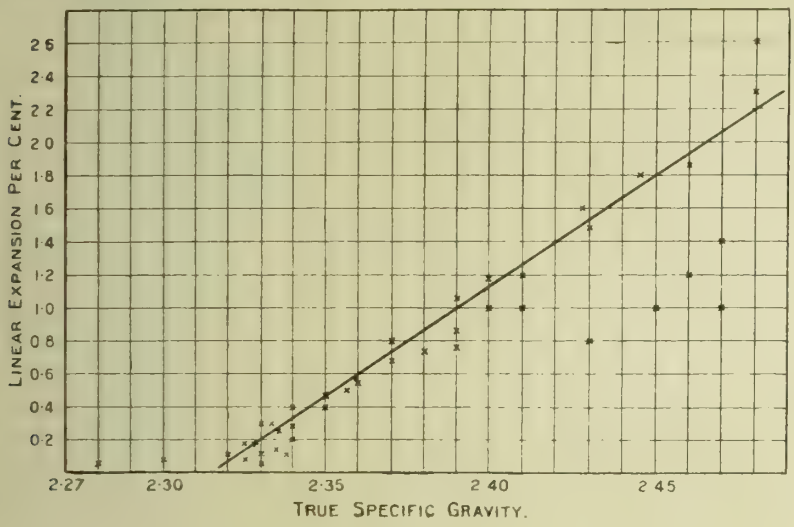


Fig. 2.

The author, in conjunction with Mr. W. Hugill, has made experiments with a view to devising a less laborious method for the determination of the powder-density of silica bricks than the usual one by pycnometer.* In testing the specific gravity of Portland cement a flask is used having a bulb and graduations on its neck. A definite volume of liquid is placed in the flask and a weighed quantity of cement is then gradually added. The volume of the cement is measured by the rise of the liquid into the graduated neck of the flask. A calculation then gives the specific gravity. The experiments indicated that although the type and size of flask used in cement teeting was not satisfactory for crushed bricks, the general method would be likely to give sufficiently accurate results.

A flask was then made as illustrated by Fig. 3†. The neck is graduated in specific gravities from 2.00 to 2.70, so that the specific gravity may be read off directly without calculation. It was found that crushing the dry brick to pass a 30-mesh I.M.M. sieve gave sufficient accuracy in the powder density determination. The method used is, therefore, as follows :—Not less than one-quarter of a brick is crushed so that it will pass through a 30-mesh I.M.M. sieve. Any metallic iron which has got into the sample in the crushing and grinding operations is removed by a magnet or magnetic separator. The flask is then filled with *xylene* up to the 250 c.c.

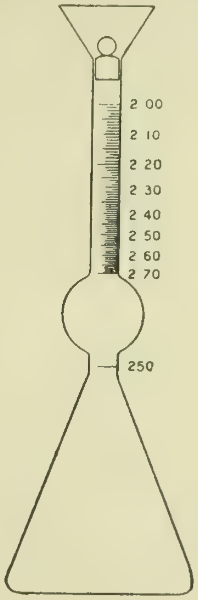


Fig. 3.

[*Continued on page* 294.

FURTHER DEVELOPMENTS
IN
FOSTER PYROMETERS

Several new forms of Pyrometers, which will be of interest to Glassworks engineers, are described in a new catalogue, just ready.

Ask for Book No. 42S.

FOSTER INSTRUMENT CO.,
LETCHWORTH, HERTS.
"The Pyrometer People."

Telephone: Letchworth 26.
RESILIA
Telegrams: "Resilia, Letchworth."

---

* Trans. Ceram. Soc. 24, 70, 1925.

† These flasks can be obtained from Messrs. J. C. Cowlishaw, 402, Chester Road, Manchester

PARKINSON & SPENCER, Ltd.

Ambler Thorn Fireclay Works,
HALIFAX, YORKSHIRE.

ESTABLISHED 1800.

Telephone : No. 1207.
Telegrams : Parkinson & Spencer, 1207 Halifax

Manufacturers of Refractory Goods of every description for the Glass industry, viz:

GLASS-HOUSE POT CLAY, FIRE CLAY, FIREBRICKS, TANK BLOCKS, BINDERS, etc.

Our Tank Blocks are unsurpassed for quality and durability.

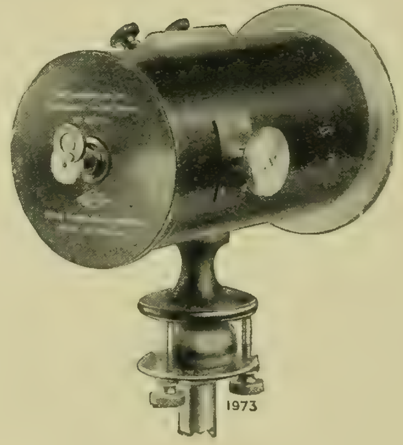
WE SPECIALIZE IN BEST POT CLAY MATERIAL.

New Plant recently erected for the cutting and dressing of Tank Blocks to any dimensions.

FAVOUR US WITH YOUR ORDERS AND YOU WILL BE SATISFIED WITH RESULTS.

FOR BETTER PRODUCTS
INSTALL
FÉRY PYROMETERS

for measuring temperatures from 500° to 1700°C.



ROBUST
ACCURATE
RELIABLE

Easily erected and operated. When once sighted, no further manipulation is required.

Indicating, recording, or combined indicating and recording outfits for one or a number of points supplied.

Further particulars are given in Catalogue No. 190—V.

CAMBRIDGE INSTRUMENT Co. LTD.

WORKS: LONDON & CAMBRIDGE
Head Office & Showrooms: 45, GROSVENOR PLACE LONDON, S.W.1.

13.

The Belgian Glass Industry.*

The series of D.O.T. Reports on the economic situation of various countries are too well known to require further introduction. We have just received one covering Belgium for the year 1925, which forms a valuable addition to the series, as in its 146 pages will be found very complete and authentic data and information with respect to almost all trades and industries as well as to the country as a whole.

In connection with the plate glass industry it is stated that during the first half of the year production was at 50 per cent. capacity, due to the increased development of the American production and the fact that the French and German factories were once more getting back to normal output. In September the output was increased to 65 per cent. capacity, and in November to 70 per cent. with the prospect of a further increase to 85 or 90 per cent. early in 1926. This increased demand is attributed to a fall in the value of the franc and large orders from American motor car manufacturers.

During the year productive capacity was increased and is now 50 per cent. greater than in 1913.

The total shipments of polished plate for the first nine months show a drop of 3,935 tons, compared with 1924, the figures being :—1924, 39,088 tons ; 1925, 35,153 tons. Amongst the chief countries with decreased demands were :—

America	1,047	tons
Argentine	739	,,
Holland	282	,,
Japan	828	,,

The chief buyers were :—

America	8,057	tons
Argentine	2,121	,,
Australia	1,044	,,
Canada	5,012	,,
Holland	1,445	,,
Italy	1,607	,,

With regard to window glass, the Report states that conditions were very stagnant until June, and in spite of a reduction of 6.17 per cent. in actual wages, manufacturers had to accept reduced prices and many curtailed output.

In June conditions improved and the figures for that month show sales of 24 million sq. ft., and a production of 20 million sq. ft. Prices were weak, however. Great Britain, Holland and South America were large buyers.

Special mention is made of a feature we have frequently referred to in this Journal, namely, the rapidly increasing proportion of window glass that is machine made. In 1924, this proportion was equal to 26.6 per cent. of the total ; 1925, 30 per cent. ; and now, with several new factories in operation, together with increased production facilities at some of the earlier mechanical works, the proportion is almost if not quite 50 per cent.

The exports of window glass had a value of 249 million francs and were equal to 146,437 tons for the first nine months ; this is a decline of 8,700 tons compared with 1924.

Chief amongst the buying countries were :—

	1925. Tons.	1924. Tons.
America	13,055 ..	10,208
Argentine	4,971 ..	—
Australia	4,971 ..	—
Brazil	3,926 ..	—
Canada	10,882 ..	—
Chili	2,142 ..	—
China	9,472 ..	17,807
Great Britain ..	30,058 ..	24,678
Holland	19,103 ..	—
Ireland	1,547 ..	—

The trade in crystal, table, and ornamental glassware was poor and stocks have accumulated in spite of reduced output and lower prices.

The total exports were 16,636 tons, as compared with 16,969 tons in 1924, a drop of 333 tons.

The chief buying countries were :—

	1925. Tons.	1924. Tons.
Australia	242 ..	833
Argentine	547 ..	—
Egypt	813 ..	—
France	2,648 ..	—
Great Britain ..	6,877 ..	7,959
India	572 ..	—
Morocco	832 ..	—

In connection with the bottle trade, the mechanically operated factories that were put into operation have had a marked influence on the imports of all types, and trade has been good.

The imports of white and half white bottles amounted to 718 tons, compared with 3,246 tons in 1924, a reduction of almost 78 per cent.

The chief supplying countries were :—

	1925. Tons.	1924. Tons.
Great Britain ..	342 ..	1,093
Germany	185 ..	835
Holland	100 ..	722

The reduction in imports of all other types of bottles amounted to 53 per cent. of the 1924 weights, the figures being, 1925, 4,026 tons ; 1924, 8,545 tons.

The chief supplying countries were :—

	1925. Tons.	1924. Tons.
France	493 ..	434
Great Britain ..	161 ..	456
Germany	1,845 ..	3,598
Holland	1,414 ..	3,289

The export of bottles of the white and half white qualities increased 330 per cent., from 546 tons in 1924 to 1,793 tons in 1925, of which Great Britain took 572 tons, France 649 tons, and French East Africa 263 tons. Exports of all other types fell 59 per cent., from 1,458 tons in 1924 to 592 tons in 1925.

---

* D.O.T. report on "Economic Situation in Belgium," published by H.M. Stationery Office, 4/- net, 4/2 post free.

TELEGRAMS:
"GLASMACHIN, ESTRAND, LONDON.
CABLES:
"GLASMACHIN, LONDON"
CODE:
BENTLEY'S.
TELEPHONE:
CENTRAL 5985.

C. SAXTON, A.M.I.E.E., M. IRON AND STEEL INST., Etc.

CONSULTING ENGINEER

Talbot House,
Arundel Street,
Strand, London, W.C.2.

BOTTLE MOULDS

ORDER YOUR MOULDS FROM

E. LUNN & Co., MOUNT STREET, GLASGOW.

Largest MAKERS of MOULDS in the UNITED KINGDOM

Quick Deliveries and Complete Satisfaction Guaranteed.

MOULDS FOR ALL TYPES OF MACHINES SUPPLIED

ALL MOULDS MADE OF CHILLED CASTINGS ONLY.

Telephone— WESTERN 2792.
Telegrams— GLASMOLD, GLASGOW.

ONE OF OUR RECENT TESTIMONIALS—

"We have one set of Ordinary Round Quart Moulds which you supplied to us which have been working for 2½ years. These are still in perfect condition, showing no cracks or any other flaw in the metal. They have been working almost continuously for the above period, only being off the machines for a week or two at a time. We have also other moulds in Square, Oval and special shapes which have been working quite as long as the Ordinary Round Quarts, although not so continuously, and these also are in perfect condition. We have always found your moulds more satisfactory than any others, and the metal you use is much more durable than any supplied by other firms."

Reference on our Testimonial File: A.B. 91.

Trade "TWENTY MULE TEAM" Mark

Granulated

BORAX

Specially refined for

ENAMELLERS AND POTTERS

BRITISH MANUFACTURE.
Guaranteed 99·50% pure.

Entirely free from phosphates.

BORAX CONSOLIDATED LTD,
16, Eastcheap, LONDON, E.C.3.

TRADE NOTES.

As was only to be expected the effects of the coal stoppage are proving rather serious to the glass trade. Many factories had good stocks of coal and others were either using oil or could quickly change over from gas to oil. Nevertheless many factories are partially closed, and more will follow unless there is a quick settlement.

◆ ◆ ◆

The estate of the late Mr. E. D. Libbey has been valued at $21,714,087.

◆ ◆ ◆

Since the increase in duty on imported window glass, referred to in our last issue, several of the Swedish factories have restarted production and others are preparing to do so.

◆ ◆ ◆

The business of bottle manufacturers previously carried on as "Gregg & Co." at Hope Glass Works, Knottingley, Yorkshire, has been converted into a private limited company with the title Gregg & Co. (Knottingley), Ltd. The registered capital is £20,000 in £1 shares.

◆ ◆ ◆

The Glass Container Association held its annual Convention on May 13th, 14th and 15th, and this year Montreal was chosen as the meeting place.

◆ ◆ ◆

Mr. W. H. Bostart, the President and General Manager of the Owens Bottle Company, addressed the Convention, taking as his subject, "Facts Should Govern our Industry," and mentioned the danger of excess productive capacity, and stated that at the present time the American productive capacity of bottles was at least 30 per cent. in excess of the country's normal requirements.

◆ ◆ ◆

The second unit of the Pittsburgh Plate Glass Company's continuous process for making plate glass was recently put into operation.

◆ ◆ ◆

According to a report in the *B.O.T. Journal* the Bohemian Glass Industry has of late suffered from the general decline of demand, exports showing a marked decrease, mainly due to the increased Customs duties in Germany.

◆ ◆ ◆

The South African Parliament has for consideration modifications to the Customs Tariff on certain articles and commodities. In the case of glassware it is proposed to increase the present duty of 20 per cent. by the addition of a suspended duty of 10 per cent.

◆ ◆ ◆

In the North of France sheet glass works are well supplied with export orders and are short of skilled workmen. The same conditions exist, i.e. plenty of orders and lack of skilled men, in the bottle works of the North and also those in the Marseilles district.

An Exhibition of British Chemical Plant will be held from July 19th to 24th, at the Central Hall, Westminster, London, S.W.1. In addition to the most up-to-date chemical engineering equipment there will also be on view a special series of exhibits of anti-corrosive materials, etc.

◆ ◆ ◆

At the annual ordinary general meeting of Messrs. Brunner, Mond & Co., Ltd., held on May 13th, it was stated that the net profit for the year ending March 31st, 1926, was £1,633,670, an increase of £63,300 over last year. The dividend for the year was 10½ per cent. (same as last year).

◆ ◆ ◆

It was announced that the Company intend spending £100,000 on a new research laboratory at the Winnington Works.

◆ ◆ ◆

Brussels, June 1.—Glass workers in the Charleroi district have given notice of a demand for a 10 per cent. increase in wages.—*Exchange Telegraph.*

◆ ◆ ◆

A group of students from the College of Technology, Manchester University, recently spent an interesting afternoon at the works of Messrs. Butterworth Bros., Ltd., Manchester. They showed surprise at the almost uncanny skill of the workers, many of whom have been with the company from boyhood to old age. A contrast was provided later when the modern method of pressing tableware in moulds was shown, this being a branch of the industry now making rapid progress. Messrs. Butterworth Bros., Ltd., claim to be the only firm in the country manufacturing fine table and confectioners' glassware in addition to all kinds of glass for mechanical, scientific and industrial purposes.

◆ ◆ ◆

In the House of Commons on Tuesday, June 8th, Mr. Pethick-Lawrence moved an amendment to leave out Sub-section 2 of Clause 10, which raises the duties on optical glass and other goods specified in the schedule to one-half instead of one-third of the value.

The amendment was defeated by 243 to 139.

An amendment moved by Mr. C. P. Williams to postpone the operation of the duty on optical glass till January next year was defeated by 274 to 137.

Sir Burton Chadwick (Parliamentary Secretary to the Board of Trade) said the duty had actually saved the optical instruments trade from extinction, and it had not increased the price of a single article. The extension of the duty to component parts, etc., would stimulate and develop British manufacture.

On a division the amendment was defeated by 240 to 128.

An amendment moved by Mr. J. Hudson to exclude the component parts of optical instruments from the payment of duty was rejected by 236 to 129.

THE SOCIETY OF GLASS TECHNOLOGY.

Annual Dinner.

Hotel Cecil, London, Tuesday June 1st, 1926.

The Society of Glass Technology.

The opening session of the annual meeting of the Society was held at University College, London, on Tuesday, June 1st, under the presidency of Mr. W. Butterworth, when Professor Sir W. M. Flinders Petrie delivered a lecture on "Glass in Early Ages."

Sir Flinders Petrie said that no glass was made in Egypt before 1500 B.C., all earlier specimens being imported. It was known that as far back as 2500 B.C. glass was being produced in the Euphrates region, and in the northern parts of Mesopotamia. Within 50 years, however, of the introduction of Syrian workmen into Egypt glass had become one of the commonest objects. One development was the production of glass beads, a popular and attractive form of the new art. None of the early specimens was of liquid glass, but had all been made from glass paste, and no blown glass was produced until the Christian era. One of the first objects of the glassmaker was to obtain colour, and early efforts were devoted to the imitation of natural materials. It was a remarkable fact that as long ago as 7000 B.C. it had been found possible by the use of empirical methods to obtain the purple-blue colouring in glass, which even in modern manufacture was one of the most difficult colours to obtain. The early activity in the production of glassware came to a somewhat inexplicable end, and it was not until the seventh century B.C. that a great revival in the art took place.

An interesting use of glass by the ancients was for standard weights, Sir Flinders Petrie continued, and examples had been found of three glass weights of the same denomination which, when tested, were found to be in agreement with each other to within 200th of a grain. The search for satisfactory methods of glazing glass dated from the earliest times, and examples of glazed beads made in the early part of the pre-Christian era gave proof of the success which had been attained.

Professor Turner, the hon. secretary of the society, proposed a vote of thanks to the lecturer. He mentioned that the funds of the Glass Research Association—now wound up—to be handed over to the Society of Glass Technology for research purposes, amounted to between £2,500 and £2,600.

At the conclusion of the meeting there was an interesting ceremony when the President of the Stained Glass Association of America, presented to the Society of Glass Technology and the British Society of Master Glass Painters a beautiful opalescent glass panel which had been executed by the American artist, La Farge.

The eighth annual dinner was held in the evening at the Hotel Cecil, Mr. W. Butterworth presiding. The touring members of the Stained Glass Association of America, and the Masters of the Glaziers' Company and the Glass Sellers' Company, were the guests of the Society.

There was some quiet amusement when Mr. T. C. Moorshead, who moved the toast to the American guests, confessed he was an American, and each of those who replied, including Mr. Henry Hunt, the President of the Stained Glass Association of America, and Mr. F. C. Brown, had to admit that they were born in England.

Mr. P. H. Grylls (representing the British Society of Master Glass Painters) supported the toast.

Mr. Henry Hunt (President of the Stained Glass Association of America), in responding, said his association welcomed the good things that were produced in this country, and the thoroughness with which they were produced. He was born in this country and received his early teachings here, and in America, in which he had made his home, he had followed that teaching. America welcomed the products of the glass stainers of England because they knew they were the best that could be produced in the world. They had no fear of competition of certain British products, but the competition they feared was that which came from the Continent. That competition America did not want.

Mr. F. L. Brown, in submitting the toast of "The City of London," said British goods were always welcome in the United States. They welcomed the thoroughness of this country's science. America had turned from a farming to a manufacturing community in the last decade. British cloths, textiles, glass, and other products were always considered standard. He went on to speak of the stained glass windows the American visitors had seen during their tour of England. They valued all of the eleventh, twelfth and thirteenth century windows, but most of all they admired the great Christopher Whall windows in Gloucester Cathedral.

Sir Edward Manville (Master of the Glaziers' Company), in responding, said his company tried to foster the beautiful art of painting on glass by conducting classes at which that art was taught. Although the company was nearly six hundred years old, it possessed great vitality.

Mr. A. L. Howard (Master of the Glass Sellers' Company), proposing "The Society of Glass Technology," remarked that in no branch of industry could it be possible for scientific research to be of greater importance than in the glass industry. The Society of Glass Technology had enrolled 102 members from the United States of America, and it carried on work of the greatest value. Within the past eight years 256 original papers and 3,921 abstracts had been published.

The President (Mr. Butterworth) said the industry had suffered greatly as a result of the general strike, and the coal stoppage because of the large consumption of coal in the industry. The aim of the society, which was only ten years old, was to pool knowledge and science among all countries. Perhaps the idea of openness came from America. Before the war the glass industry was a thing of jealousy and distrust with closed doors, but now they had a friendly co-operation all round. There was no doubt that in Great Britain there was one of the world's most valued collections of stained glass.

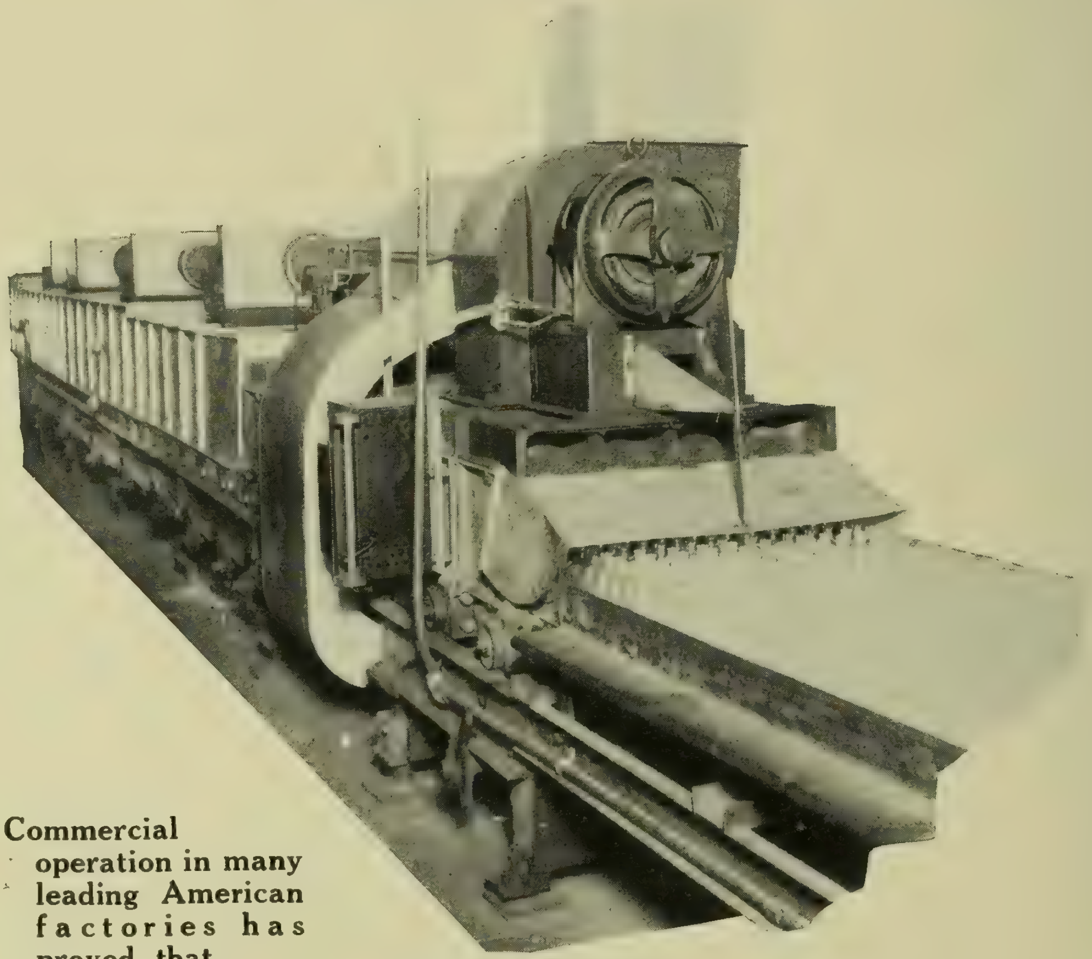
Responding to the toast to himself proposed by Mr. Coad Pryor, Professor Turner mentioned that next year the Society hoped to hold a glass convention in which they would try to demonstrate the very great work the industry did to the community in all its branches.

Another Scientific Development

THE HARTFORD LEHR

IS CREATING

A NEW STANDARD OF ANNEALING



Commercial operation in many leading American factories has proved that

THE HARTFORD LEHR

1. Gives **"GRADE A" ANNEALING AT ALL TIMES**
2. Saves FUEL (as high as 85% saving has been shown).
3. „ WARE (No "Lehr Loss").
4. „ LABOUR.
5. „ SPACE.
6. „ UPKEEP EXPENSE.

The British Hartford-Fairmont Syndicate Ltd.

142 - 143 Audrey House, Ely Place, London, E.C.1

"HARTFORD" AUTOMATIC FEEDERS - FORMING MACHINES - LEHRS

The British Refractories Research Association.

A Brief Review of Its Work.

It has been stated on many occasions that the progress made in the improvement of the refractory materials necessary to the glass industry has not kept pace with that made in the industry itself, with the result that, at the present time, the quality of the refractories available is really holding back further improvements and advances connected with furnace design and operation, new glasses, and also improved productive equipments.

This statement may be an exaggeration of the situation, but nevertheless, the glass maker's interests are irretrievably bound up with refractories, so that under these circumstances the work of this Association becomes of increased importance and cannot be known too widely.

We have received from the Secretary of the Association at 22, Surrey Street, Strand, London, W.C.2, a copy of a report by Dr. J. W. Mellor, the Director of Research, entitled *A Review of the Work of the B.R.R.A. mainly from the User's Point of View.*

A large portion of this report has a direct interest to glass manufacturers and we have accordingly obtained permission from the Department of Scientific and Industrial Research to publish it.

The Secretary of the Association will be pleased to give all information as to terms and conditions of membership, on application at the address previously mentioned.

The research work arranged by the Council of the B.R.R.A. has been devised to cover simultaneously problems connected both with the use and with the manufacture of refractories. It will be at once recognised that, while certain problems refer solely to the manufacture of refractories, others are specifically concerned with their use. Much might be said about the misuse of refractories. Indeed, in the present state of our practice, it is perhaps as important to be able to recognise when we are misusing our refractories as it is to know how to manufacture better refractories, or how to make the best refractories at a smaller cost. For instance, I have seen a minute alteration in the position of the tuyères of a cupola change the life of the refractory lining from days to months. Analogous conditions arise in connection with the linings of other types of furnaces. This illustrates how refractories may be improved by better usage. Research in the using of refractories is just as important as research in their manufacture. In order to know what may be reasonably expected from our refractories we must find out more about their behaviour in use.

Similarly, too, the designer of furnaces must learn the capabilities of refractories so that his designs may not test the resources and skill of the manufacturer, but rather get the best out of the materials themselves. For instance, it is not uncommon to see specially designed blocks which must be a continual source of anxiety when the blocks are being made and when being used. The blocks are designed with little regard to the peculiarities of the material from which they are made. Their manufacture is a *tour de force,* a feat of skill, showing what can be made ; but all the time it is forgotten that, if clay and silica materials are to do their best work, they must be humoured both in manufacture and in use. Clay, to be conquered, must be obeyed.

Again, while we may be feverishly anxious to make improvements in manufacture, we are likely to reap more lasting benefit by making sure that we understand the meaning of the fundamental operations. So long as we are ignorant of the fundamental principles, we are nothing more than impotent spectators when things go wrong in manufacture or in use. If we are to conquer our materials and operations, it is absolutely necessary for us to learn the fundamental principles which must be obeyed. Knowledge before control. Any other policy would be a short-sighted one ; it would sacrifice perdurable benefits for ephemeral gains.

The main problems which have so far been treated by the research men fall into a few clearly defined groups, and the members of the staff who have these problems allocated to them by the Council can now be regarded as specialists in their particular departments.

Movements of Heat in Furnaces.

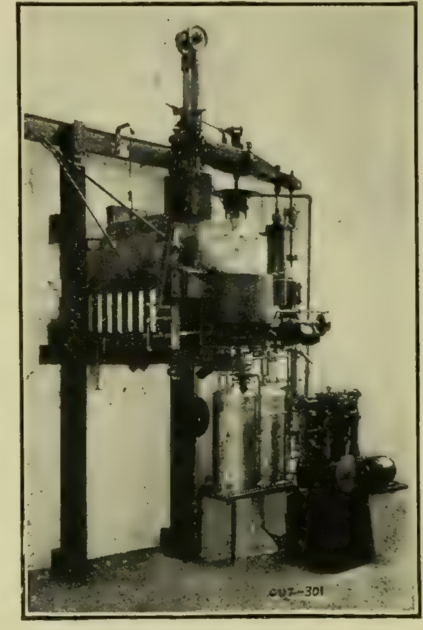
Mr. A. T. Green has had certain questions propounded to him in connection with the thermal conductivity of furnace materials ; the radiation of heat from furnace walls ; and the part played by radiation in distributing the heat in the interior of large furnaces. This work is by no means completed, but some important facts have been elicited, and fundamental data established. One fact has changed our outlook. We have grown up with the idea that the more porous a firebrick, the less did it conduct heat ; so that, other things being equal, a close-textured brick or quarry was considered to be the better type for muffle-walls. An open-textured brick was supposed to offer more resistance to the passage of heat, and this the more, the greater the porosity. Closer investigation has shaken our faith in this time-honoured rule. The rule is valid only at comparatively low temperatures. For temperatures over about 1,200°, the old specification for firebricks must be revised, for there is a reversion ; the old order changes, within limits, depending on the nature and disposition of the pores, high porosity favours the passage of heat through muffle walls, etc. Conversely, at these high temperatures, a close-textured brick is the better insulator. There is no need to emphasise what this means in the selection of firebricks for a particular job. Incidentally, this work has involved some careful and laborious measurements on the thermal properties of refractories

MODEL KFO.

LATEST
MILLER
FEEDER

卐

PROGRESSIVELY
DEVELOPED
SINCE 1907.



WILLIAM J. MILLER, INC.
SWISSVALE, PA., U.S.A.

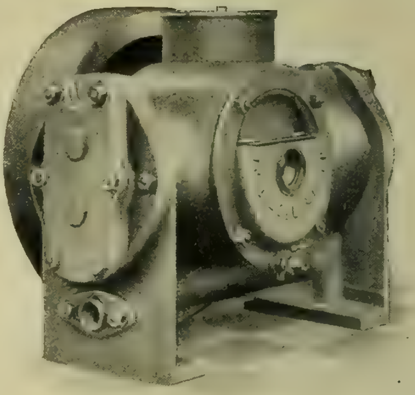
London Office: 386 STRAND, LONDON, W.C.2 Tel. No.: REGENT, 5647.
Cable Address: AUTOGLASMA, RAND, LONDON & AUTOGLASMA, PITTSBURG, PA.

AIR COMPRESSORS
& VACUUM PUMPS

As Illustrated
in 5 sizes
from
10 to 80
cubic feet per
minute

Other types
Larger sizes

Any Pressure
or Vacuum



LACY-HULBERT & CO., LTD.
BOREAS WORKS, BEDDINGTON
NR. CROYDON, SURREY
Telephone: CROYDON 1698.

MOULDS

YOU ARE BOUND to improve the quality and output of your bottles and jars if you use **GOOD MOULDS.**

We supply moulds having the highest possible workmanship and finish. They are produced from the best crucible chilled castings and are machined throughout to precision gauges by practical mouldmakers.

Our service of quick deliveries and guaranteed accuracy in all respects is backed by **LONG PRACTICAL EXPERIENCE.**

We specialise in mould equipment for **LYNCH, MILLER and O'NEILL** automatic machines but any and all types of moulds are undertaken.

No Order too Large. No Order too Small.

We also supply Glassworks patterns and crucible iron castings of all descriptions.

JOHNSON RADLEY & SONS, Ltd.,
Chesney Works,
Hunslet, Leeds.

Telegrams—MOULDS, LEEDS
Telephone—LEEDS 21354.

Now Ready!

Volume II

Industrial Furnaces

By

W. TRINKS, M.E.

Fuels, Furnace Types and Furnace Equipment; Their Selection, and Influence Upon Furnace Operation.

The ONLY BOOK *in* ENGLISH *available on this important subject.*

405 PAGES. 292 FIGURES.
27/6 net (VOL. 1, 22/6 net)

GLASS PUBLICATIONS LTD.,
TALBOT HOUSE,
ARUNDEL STREET, STRAND,
LONDON, W.C.2.

at high temperatures, and all the data are now available for calculations on the efficiencies of furnaces, etc. Full details have been published in the *Bulletin*.

The Insulation of Furnaces.

This work has also been applied to the insulation of furnaces and kilns. The importance of this has long been known. There is in some cases a serious disadvantage in raising the efficiency of the insulation of certain furnaces, or perhaps I should say parts of furnaces. The increased temperature which results from the augmented insulation may shorten the life of the refractory lining as much as to stultify the advantage gained.

Are Silica Bricks better Heat Conductors than Firebricks ?

Several other interesting points have appeared in the course of this work. It is often stated that silica bricks are better conductors than ordinary firebricks. The facts are that, although the temperature gradient—i.e. the difference of temperature between the two ends of a silica brick—is invariably less with well-fired silica bricks, a fireclay brick is often a better conductor of heat than a well-fired silica brick of temperatures below 900°. At a higher temperature there is a reversion, and the silica brick is the better conductor.

The Effect of Mechanical Stresses on Refractories.

The effect of temperature on the mechanical properties of refractory materials has occupied Mr. A. J. Dale's attention for about three years. The effect of load on refractories had been under observation some years previously. It had been established that the more siliceous types of refractory resist the effect of load better than the more aluminous types. The effect of load on the best types of fireclay is astonishing. A firebrick made from the best clay which will stand up at temperatures near 1,700° breaks down at about 1,400° under a load of 50 lbs. per sq. inch.

The Americans have a load-test which, they prescribe, a refractory must pass before it complies with the specification. The Refractory Materials Committee of the Institution of Gas Engineers felt that our knowledge on this subject was far too meagre to justify any such test, and, therefore, that Committee asked for more light.

The work has necessitated the overhauling of the complex subject of the vitrification of refractories, and their fire-resisting qualities under mechanical stresses. The work is developing very well, but it is difficult to summarise in a few short sentences. It is not investigating the bearing of the facts on the corrosive effects of slags ; on the destructive effects of powdered fuel and ordinary coal in boiler furnaces ; and on the action of dirty produce gas on the regenerators of furnaces, the roofs of open-hearth furnaces, gas ports, etc. This work, as it develops, is reported in the *Bulletin* in the usual way.

Action of Furnace Gases on Refractories.

Another research is in progress by Mr. A. E. J. Vickers on the effect of different atmospheres on refractories. So far as refractories go, the presence of the two carbon oxide gases, and of sulphur dioxide in the atmosphere make the material rather more fusible ; with hydrogen, there is a still greater fall in the refractories ; but with steam there is the greatest effect of all. For example, a refractory material was found to soften in an atmosphere of steam at a temperature 300° below that at which it softened in oxygen or in air. This statement of fact emphasizes the need for extending our knowledge of the effects of furnace atmospheres on the refractory linings. It gives us a hint of a possible explanation of the extremely discordant results we are constantly hearing about the behaviour of refractories. Messrs. X will not have Messrs. A's firebricks because they have always give bad results, whereas Messrs. B's firebricks are always good ; Messrs. Y, a similar user to X, will not have B's firebricks because the results are always bad, whereas A's firebricks are always good. Mysteries like this can be cleared up only by slow and painstaking observations such as are contemplated in the present research. There is also the slow deterioration of firebricks in certain atmospheres to be considered. Messrs. Rees and Hugill have done some work on the effect of salt vapours on coke oven bricks. So far, however, we have only nibbled at what promises to open into a very big subject.

Clay-bonded versus Lime-bonded Silica Bricks.

It is stated in one of our *Bulletins* that the lime-bond for silica bricks may have been deliberately selected by our respected ancestors because it gave better results than other bonds—say clay. Unfortunately, there is nothing to show that they did so ; and it may have been that the lime-bond was found to do the work required, and we have since been perfectly content to follow the good old maxims. Let well be ; the Devil we have and know, is better than the Devil we do not know. Small-scale trials have shown that a clay-bond applied in about the same proportions and in the same manner as the lime-bond was worth following up. Mr. W. J. Rees was, therefore, asked to test the question : Is the lime-bond the best for the job ? A long and arduous investigation has been made on this subject. Clay-bonded silica bricks and lime-bonded silica bricks have been made on a large scale under ordinary manufacturing conditions, and compared side by side in industrial furnaces. Mr. W. J. Rees' report will soon be issued as a special *Bulletin*. The general conclusion is to show that there is no particular advantage in substituting the clay-bond for the lime-bond ; but, under special circumstances, wherever spalling difficulties are causing serious trouble, clay-bonded bricks give the better results. In fine, we now have the very important new fact definitely established. Clay-bonded silica bricks are not so liable to spalling as are the lime-bonded silica bricks.

Sillimanite Bricks.

Mr. W. Emery has had in hand for a long time the possibility of utilising Indian natural sillimanite as a refractory. At the present time there is in use a gas-retort, and a number of bricks, made from sillimanite. This work was given over to Mr. Rees, and he is studying the behaviour of these bricks in industrial furnaces. The general conclusion is that, where high refractoriness is the main factor, sillimanite bricks are superior to the

New DEVELOPMENTS in
GLASS FURNACES:

TEISEN New Wasp-Shape continuous Tank Recuperative Type

with longitudinal travel of flame. The most up-to-date Machine Tank, possessing Stream line features and securing:

HIGH EFFICIENCY
LONG LIFE
CONSTANCY OF TEMPERATURE
EASY MEANS OF REGULATION
GOOD ACCESS TO REPAIR TO THE THROAT

TEISEN New T Shape Cross Flame Tank Regenerative Type

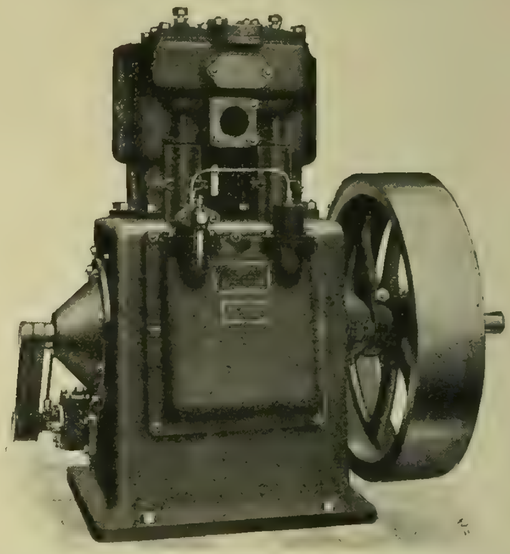
For the largest capacities securing:

HIGH OUTPUT WITH ECONOMY OF FUEL by better utilisation of the flame. Designed on the principle of the Modern Open Hearth Furnace.

LET ME STUDY YOUR PROBLEMS.
Individual Attention to all Furnace Matters.

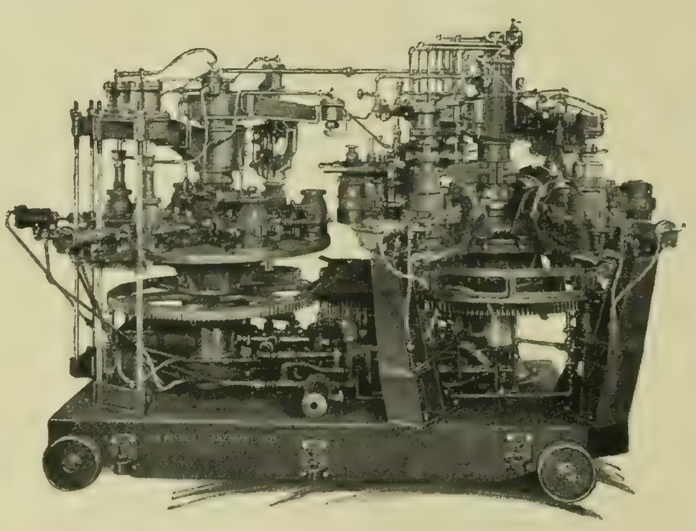
Write Now—
Th. TEISEN, C. E.
Furnace Engineer,
20a, Temple Street,
BIRMINGHAM.
'Phone—Central 1806. *Cables*—TETE, BIRMINGHAM

"BROOMWADE"



AIR COMPRESSORS
BRITISH AND BEST
FOR ALL DUTIES.

BROOM & WADE, Ltd., HIGH WYCOMBE.



The New O'Neill No. 44
Blowing Machine.

A well-built, high speed blowing machine with a range from 6 oz. to 40 oz. in capacity. Operating speeds up to 23 per minute depending on the class of ware being made. Have our London representative give you the details.

THE O'NEILL MACHINE CO.,
TOLEDO, OHIO, U.S.A.

LONDON OFFICE: 10 SAVOY ST., STRAND, LONDON, W.C.2.

highest grade of firebricks, but they do not so well resist the corrosive attack of iron oxides and ferruginous sands at high temperatures. The sillimanite bricks, however, do resist, exceedingly well, attack by slags, etc., of the nature of ordinary glass.

Grog Bricks.

In connection with the Refractory Materials Committee of the Institution of Gas Engineers, the question was raised whether it would be possible to make firebricks from grog, using a clay-bond much in the same way as the lime-bond is used in silica bricks. If this were practicable, drastic economies could be made in the cost of manufacture. Mr. Mottram made some experiments in the Stoke laboratories on this subject; and Mr. Emery made a number of bricks and had them installed in the settings of the retorts in two gas works. These grog bricks were lost during the dismantling of one furnace; they were quite satisfactory in the other. The work was then allocated to Mr. Rees, and, so far as the work has progressed, his results are very promising.

The Purification of Fireclays.

Many manufacturing problems have been investigated. Mr. S. R. Hind has made a very elaborate report on the purification of fireclays with the idea of making low grade fireclays into high grade fireclays; and of making high grade fireclays into the best possible. The job was done on a large scale. The plant alone involved an outlay of over £800. The general conclusions were that the cost of purification was out of all proportion to the improved results attained, and that the extra cost entailed by the purification would shut off the market for the improved firebricks.

The Efficiency of Kilns.

An extensive report on brick kilns has also been made by Messrs. Hind and Emery together with their assistants. This work was done for the Building Research Board, and it will probably be published by that organisation before very long. There are many questions discussed in that report which are of general interest to all users of furnaces. A summary of the report is to appear as a special *Bulletin* of the B.R.R.A.

Miscellaneous.

Mr. W. J. Rees and his assistant, Mr. W. Hugill, have also developed some interesting things which might be termed side-issues to their main-work; and these will be found in the *Bulletin.* There is an instructive report by them in the *Bulletin* on the deterioration of silica refractories when stored under unfavourable conditions. There is also a report by myself on some causes of the variation in sizes of refractories. The effect of the low specific gravity forms of silica in favouring the spalling of silica bricks at relatively low temperatures has also been the subject of some investigations by Mr. Green. The general subject of spalling is also receiving attention. Work, by Mr. R. S. Troop, assisted by Mr. F. Wheeler on the drying of large blocks is well underway; and an examination of the efficiency of mixing machinery has just been started by Mr. Hind. Work on the safe rate of burning bricks has been interrupted owing to the departure of Mr. L. S. Theobald, but is being resumed by Mr. Green and Mr. Vickers.

Conclusion.

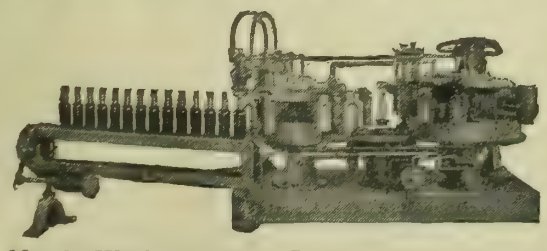
If we consider the work done, we are delighted with the progress which our Research Staff has made; if we consider the work to be done, we are dismayed by the appalling mass which remains. High temperature chemistry is in an embryonic stage; the chemistry of the silicates is no further developed. Unlike present-day workers in physics and chemistry, our Research Staff has had no heritage of precise facts bequeathed to it by past workers in science.

J. W. MELLOR.

(*Continued from page 298.*)

which apparently the Board of Trade intends to set up if the present Bill becomes law.

It is by no means certain that British manufacturers will rush in to claim that all imported glassware should be marked with an indication of its origin. There is always the danger that foreign countries which supply these goods will promptly develop an intensive advertising campaign urging their products on the public, and, as these products will then *ex hypothesi* be easily identifiable, British manufacturers in certain lines may find themselves in a worse position than now unless they are themselves prepared to spend a great deal of money in a counter-advertising campaign. There is also the vexed question of overseas markets both in regard to export and re-export business.



AUTOMATIC
NARROW NECK AND WIDE MOUTH
BOTTLE BLOWING MACHINE
No Transfer Boy. No Take-Out Boy.
STRICTLY AUTOMATIC
When Operated with Mechanical Feeding Device.
Can be Worked by Hand Gatherers. Speed 10 to 32 Bottles per minute, ranging in size from ¼ oz. to Gallon
May be Worked on Floor Level—No Pit Needed
LYNCH GLASS MACHINERY COMPANY,
ANDERSON, INDIANA, U.S.A.
Cable Address—"LYNCHNOBOY" ANDERSON
Codes—A.B.C. 5th EDITION, BENTLEY'S, WESTERN UNION

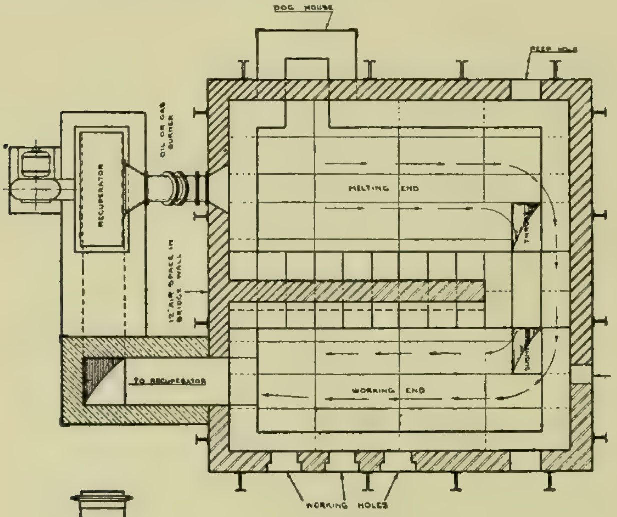
NEW TYPE FURNACE.

The Simplex Engineering Company, Washington, Pa., U.S.A., recently acquired the rights to build a patented continuous tank furnace, which they call a " U " tank

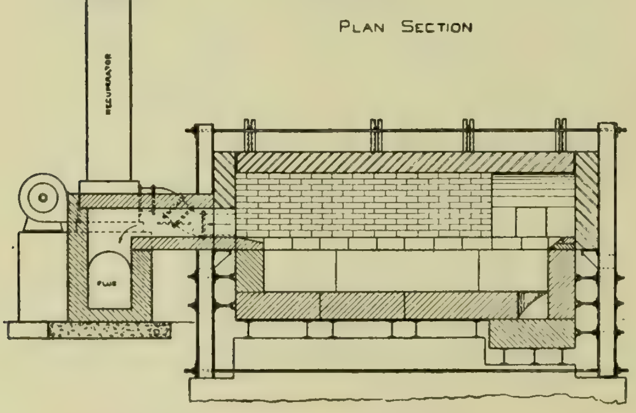
The furnace was designed originally for melting a very high quality glass and some exceedingly good results have been obtained.

The metal depth is only 18 inches, and an output of one ton of glass per 24 hours per 7 sq. feet melting area is achieved, with a fuel consumption of between 8,000 and 10,000 cu. feet of natural gas (or its equivalent) per ton of glass.

These figures are subject to slight variations depending upon the type of glass being melted, but the furnaces have been used for making high quality opal, as well as first quality crystal, various coloured glasses, borosilicate and other special glasses.



PLAN SECTION



SECTION

The furnace is of simple construction and the use of a metallic recuperator minimises excavation and construction costs, as will be seen from the diagrams. Furthermore, it is claimed that it is possible to tap a tank and have it working on a different glass inside 48 hours.

The design would appear to reduce the external radiation surface to a minimum, and this no doubt accounts to a large extent for the low fuel consumption.

SULPHUR IN PRODUCER GAS.

In Report No. 89 of the Fuels Committee of the German Iron and Steel Institute it is stated that the addition of from 2 to 3 per cent. of freshly burnt or freshly slaked lime to the coal to be gasified will be of material assistance in reducing the amount of sulphur vapour present in the resulting gas. By this method a considerable portion of the volatile sulphur combines with the slag in the producer, and the report states that considerable success has been achieved with the method suggested.

◆

HEAT RECOVERY IN GLASS FURNACES.

The economies to be effected by the pre-heating of the air for combustion in connection with glass furnace operation is fairly well known, but in a recent article* Bjarne Schieldrop mentions that metallic recuperators are now available, capable of withstanding continuously exposure to temperatures up to 2400° F. (1315° C.) without scaling.

The author also mentions a type of recuperator recently introduced, in which the available heating surface is increased without increasing the overall dimensions. This is attained by adopting the regenerative principle and causing the hot waste gases and the air to be pre-heated to pass through the same chamber at different times.

The hot gases give up their heat to the metal plates which afterwards in turn give up their heat to the air. By working three or more of these chambers in conjunction, a continuous flow of both air and waste gases is obtained. A set of valves operated by one common mechanism continually diverts the flow of gas and air from one chamber to the other, so that, although each chamber acts in the nature of a regenerator, being alternatively heated and cooled, yet, considered as a whole, i.e. from the inlet and outlet to the furnace, there is a continuous flow in one direction only, as is the case with the ordinary recuperator.

With this type of equipment it is possible to obtain a heating surface of 10,000 sq. feet, in a space only 10′ 6″ long by 7′ 6″ wide and 10′ 6″ high.

A continuous glass tank with an output of 35 tons per 24 hours is now under construction, the recuperators being designed for a waste gas temperature of 2100° F. (1150° C.) and a pre-heated air temperature of over 1750° F. (900° C.).

---

* Fuels v. Furnaces, May, 1926.

Continued from page 281].

mark and 100 grammes of the crushed brick, weighed out in a counter-poised scoop, are gradually sprinkled into the flask. The flask is gently agitated to free any air-bubbles which may have been carried down; it must be held by the neck only, to avoid the introduction of error through raising the temperature of the liquid. After standing for two minutes, the powder density is read off directly from the level of the liquid in the graduated neck of the flask.

(*To be continued.*)

The Source of the Coloured Glass used in Mediaeval Stained Glass Windows.

By JOHN A. KNOWLES.

(*Continued*).

Another glass-painter, Jacques Damen, tried three years later without success to obtain coloured glass for the windows of the Nave at Auch, which it was intended should match those previously erected in the choir by Arnaud de Molles. Writing to the Chapter in 1643 he said, " This is to inform you that I have written to the chief commercial centres in France to obtain coloured glass, and can find none." He had " enquired of those gentlemen who make glass," but he had " not been able to obtain a satisfactory reply from them." " You must not, however," he added, " stick at trifles, for coloured glass will be very dear." He told the Chapter that a letter from them sent through Mr. Maugin, merchant and addressed to Mr. Charles de Hanse, in the Gisi Wood, in the parish of Savigni de Nevers, would carry more weight than anything he himself could do.

But it would appear that neither the glass-painters' money nor the churches' influence was able to obtain coloured glass. Four more years went by, when another glass-painter, Joseph Darnes of Toulouse was called in, and a contract was drawn up with him to fill the twelve windows of the Nave with a series of windows depicting the Twelve Mysteries of the Virgin, in an array of colours including violet, yellow, vinegar, purple, amaranth, green, lake, red, blue and dove grey. But the authorities were evidently by no means sanguine that these aspirations would be realised. They seem rather to have regarded them in the light of a pious wish but a forlorn hope. Seven years of enquiries and waiting had evidently taken from them any expectation that their original scheme was possible of realisation, and they had reluctantly prepared themselves for the worst. If they could not get figure subjects glowing with all the colours of the rainbow, they were ready to put up with plain quarries relieved with a border in stain and enamels. The contract therefore provided that " since the said Darnes has hesitated to undertake to represent the said mysteries, for fear of not finding sufficient coloured glass, it has been agreed that he shall not be bound to do so if in three months from this day the said authorities have not indicated to him any merchants in France from whom it may be obtained." (M. de la Carsalade du Pont. " Les Verrieres des nefs de la cathedrale d'Auch." Revue de Gascogne 1897. p. 387.)

Three months passed. No coloured glass was forthcoming, and Darnes eventually made the windows according to the alternative contract " of plain glass lozenge-shaped with various ornaments of cherubim, fruit and flowers in bright colours," in the traceries which are to be seen to-day, the " bright colour " being a blue enamel, the only available enamel to which the description " bright " could then be applied.

One of the most extraordinary aspects of the whole question of the sudden cutting off of the supply of coloured glass at the source by the overthrow of the Lorraine glass houses, is that the manufacture of it should have been confined to so comparatively small an area. Tradition states that the glass works established on the banks of the Rhine by the Romans survived the downfall of the Empire, and it was possibly the same in Lorraine, and that the glass-makers there had kept the making of colours as a secret for centuries. Whether this was so or not, it is nevertheless surprising that the knowledge had not spread to a wider area—to France for example. But there is an accumulation of evidence which suggests that in no part of Europe but that comprised by Lorraine, Flanders and Southern Germany were there manufacturers who know anything about it. There was certainly no one in England.

As regards France, the first Auch Cathedral contract made in 1620 specified Lorraine glass. The second made in 1641 for the upper window of the Nave stipulated that " genuine Lorraine glass " was to be used. The third contract for the lower windows of the Nave is even more definite. In that document it was insisted upon that the glass should " come from Lorraine, Germany, or any other country, but not from France," whilst if plain quarry work only was eventually decided upon " good and true glass from Lorraine or Laprade but not from France," might be used.

Jacques Damen, one of the glass-painters previously mentioned in connection with the earlier negotiations for the Auch windows in 1643 wrote to the Chapter that he had been enquiring amongst French glass manufacturers for coloured glass, but he said " I believe they do not thoroughly understand the matter, but one of their people has advised me that they can make it at the glass-works at Nevers." This glass, however, seems to have earned a reputation for cracking, and Maurice and Antoine, the two Recollect fathers who wrote a treatise on glass-painting, the former of whom died at Nevers in 1709, say that Nevers glass should not be used as it cracked in the kiln. (" Le Vieil L'Art de la Peinture sur Verre," p. 230). Hardiques de Blancourt in 1699 tells us that as for making coloured glass, the French glass-makers of his time " who publickly profess the Art of Making (coloured) Glass, know nothing of it."

As regards Italy, although the Venetian glass-makers had made themselves world-famous for crystal, they do not seem to have understood the making of coloured window glass. We have the authority of Vasari, who had studied glass-painting under William of Marseilles, and who was therefore in a position to know, that his master used German glass, as the Italian was too dark. Gyles, the glass-painter of York, tried in 1693 to get glass from Italy through his friend Dr. Place, who enquired from a man who had "practised (at) ye Muran for severall years," evidently as a lamp worker. Though not a practical glass-maker, he cannot have been entirely ignorant of glass-manufacture. Yet it seems he had never heard of flashed glass, and "as to bright or light scarlet, he never see any in all his dealings with glass, and (believes) that they are totally ignorant of its manufacture even in Venice." (J. A. Knowles. "Henry Gyles, Glass Painter of York." Walpole Soc. vol. xi. p. 69.)

Nor was Spain able to produce coloured glass; all of it had to be imported. Thus in 1485 (another instance which occurred in 1458 in connection with the same cathedral has been given previously) when the authorities of Toledo Cathedral needed glass for their windows, they handed a sum of 150,000 "maravedis" to Master Henry, their glass-painter, and told him "to proceed to Flanders or any other part he may desire, where good glass is to be found, white, blue, green, scarlet purple, yellow, or grey equal in thickness to the sample which he bears and brings us thence such quantity as he has need of for the windows of our Cathedral." (Zarco del Valle. "Documentos Ineditos para la Historia de las Bellas Artes en Espana.") Nor had the art of making coloured glass reached Spain two hundred years later, for thirty-three windows in Segovia Cathedral remained unfilled for lack of the required materials until 1676, "in which year," we are told, "a canon of the cathedral named Tomas de la Plaza Aquirre succeeded in rediscovering a formula for the practice of this craft and the panes yet needed were made and coloured at the glass works at Valdequemada by Juan Danis, who owned and worked the factory under Plaza Aquirre's supervision." (Leonard Williams. "Arts and Crafts of Older Spain," vol. ii. pp. 247-248.) It is not, however, perfectly clear whether these windows were made of pot-metals or coloured with enamels.

It must not, however, be supposed that the art of making coloured glass was entirely lost. No doubt it was still carried on by Lorraine refugees in various holes and corners of Europe, else whence was the coloured glass obtained which was used in small works until quite a late date, as, for example, in the beautiful Swiss glass paintings. Moreover recipes have always been available in such works as those by Kunckein and others. Also many refugees returned to Lorraine after the wars which terminated in 1660 by the secession of that country to France, and re-erected their furnaces. One, Therry Lambotte, for example who had had a furnace on the banks of the Meuse near Namur, which had been destroyed, returned, and having rebuilt it, applied for a protection for a period of nine years. Others refused to stay under French rule. Francois Duguesne, who had had a glass factory at Fourmies, was one of these, and he obtained the right to set up in any part of Hainault he might wish. (Hondoy. "Verreries à la Facon de Venise." Paris, 1873.)

In the eighteenth century coloured glass was however still largely used by English artistes such as Peckitt, even including the ruby colour. In 1769, for example, we find another English artist Robert Scott Godfrey, exhibiting in Paris a window "painted" according to the notice of it published in the "Mercure de France" (vol. 1, p. 185, July 1789, quoted by Le Vieil p. 246 note) "in the style of the ancient church windows, in which the colours are most beautiful, very lively and rich, and where are to be seen those which were formerly employed, yellows, oranges, reds, purples, violets, blues and greens of different shades."

This glass was evidently made at Stourbridge, for Dr. Pococks in his "Travels Through England," 1751, gives us the first definite evidence of the manufacture of coloured glass on a commercial scale in England. He wrote, "1751, 8 June, came to Stourbridge, famous for its glass manufacture, which is here coloured in the liquid of all the capital colours, in their several shades, and if I mistake not is a secret which they have here."

No doubt, as in the case of Utynam in 1449, spasmodic attempts had from time to time been made to establish the industry, but never with any degree of success. The York glass-painter, Henry Gyles, experimented and produced some glass which he used on his window for University College, Oxford. (J. A Knowles. "Henry Gyles, Glass-painter of York." Walpole. Soc. vol. xi. 1923) and about the same time the London Glass-painters William and Joshua Price issued an advertisement stating that "whereas the ancient Art of Painting and Staining Glass has been much discouraged by reason of an opinion generally received that the Red Colour (not made in Europe for many years) is totally lost; these are to give notice that the said Red and all other colours are made to as great a degree of Curiosity and Fineness as in former Ages by William and Joshua Price, Glaziers and Glass-Painters, near Hatton Garden in Holborn." ("Archaeol. Journal" xxxiv. p. 103.)

There is no need to take the above statement too literally, for it is more than doubtful whether the Prices actually made glass themselves, but it is quite possible they employed a Lorraine refugee to do it.

Le Vieil writing in 1774 to plead that the craft of glass-painting be revived and restored to its former greatness, tells us that the white glass made in France was no use for staining, and that coloured glasses were no longer made at all. However, his grandfather in 1689, had been able to obtain both blue and ruby glass from a factory at Orleans run by a sieur Perrot ("L' Art de la Peinture sur Verre" p. 193). He conjectured that coloured glasses were still made in England, firstly because they were employed in the works of English artists such as Peckitt's windows at New College, Oxford, and the window by Godfrey previously mentioned, and secondly because the English book "The Handmaid to the Arts" 1758 which he came across whilst writing his treatise and which was evidently an eye-opener to him, contains explicit instructions on the production of colours." But he asked "In lieu of coloured (i.e. flashed) glass which is no longer made in our glass works might not they (the glass-painters) use those sheets of glass tinted throughout their substance, which Bohemia, and at present Alsaces can supply?" ("L'Art de la Peinture sur Verre" p. 167.)

In another place he tells us that sheet glasses of all colours were made by a Bohemian firm named Heller and Co., who have a warehouse at St. Cloud near Paris. (Ibid. p. 183.)

The Increased Optical Glass Duties.

(By OUR CITY CORRESPONDENT.)

The Report of the Board of Trade Committee in regard to Key Industries Duties, a large part of which was published *in extenso* in the last issue of GLASS, has, of course, not failed to evoke a challenge from the Trade. Strong criticism is reflected at the way in which the question has been handled. It is complained that a very small committee which contained not a single member of commercial experience, sat in camera and formulated recommendations obviously based on ex parte evidence. In 1922, after the Key Industries had been in force for some months, an application was made by British manufacturers for the duties on German imports of optical glass and optical and scientific instruments to be doubled. This application was referred to a Committee who heard evidence in public. Counsel for the applicants was Sir Arthur Colefax (who is a member of the present Board of Trade Committee). Counsel for the opponents was Sir Thomas Inskip, the present Solicitor-General. The Committee having heard the evidence of all parties, unanimously refused to recommend the increase. By way of contrast, it is urged, we now have an utterly different procedure adopted, which does not seem to be fair to the trade at large.

Fuel has been added to the flame by the fact that the Chancellor of the Exchequer has promptly adopted the findings of the Committee and increased the duties in the Budget. Even worse than this, he proposes to give effect to the increases as from May 1st. This date was within a week of the issue of the Committee's Report, and within four days of his Budget announcement. As the Key Industries Duties in any case promise security for a period of five years at 33⅓ per cent. and were not due to expire until August 19th, it is felt to be a serious hardship on traders and consumers (many of whom are themselves British manufacturers utilising certain necessary foreign imports) that the sudden new changes should be imposed without warning on goods actually in transit or coming forward under short term contracts placed in the normal and legitimate course of business.

This aspect of the matter will no doubt be argued very fully and forcibly in the course of the debate in the Committee Stage of the Finance Bill, which will be taken in the House during June. Meanwhile the importers have banded themselves together to urge their case in appropriate quarters and a memorandum which they have prepared contains *inter alia* the following paragraphs :—

1. Presumably it is sought to increase these duties in consequence of the report of the Committee appointed by the Board of Trade dated March 29th, 1926, and published by the Stationery Office as a White Paper towards the end of April.

2. This Committee heard no opposition regarding these optical goods and it is practically certain that the whole of the conclusions to which they came were arrived at by hearing the evidence of only one party, namely, the home manufacturers.

3. Not only was this course unfair, but it is contended that the Committee could have come to much more accurate conclusions had evidence been heard from the other side.

4. It should be pointed out that the optical industries throughout Europe are going through a period of extreme depression. The British section of the industry is not suffering as a result of foreign competition but mainly through the withdrawal of Government orders. The largest firms in the trade were, before the War, principally engaged on Government contracts. A number of smaller firms sprung up during the War and these were also kept going by Government orders for material required in connection with the War. Now that, partly through motives of economy, but mainly because of the lesser expenditure in armaments, Government support has been withdrawn, and whatever duties are imposed upon imported optical instruments, depression will still remain because a market large enough to keep all these firms going is not in existence.

5. In the case of luxury articles, such as cameras and lenses designed for amateur use, depression also exists throughout Europe which mainly is to be attributed to the fact that, owing to the general depression, luxury trades cannot find markets for their products.

6. A most important point which must not be overlooked is also that, before the War the home industry had a large export trade. This has, to a very great extent, disappeared.

7. It should be noted that the competing firms trading in this country have never cut prices. Generally speaking the apparatus of such leading firms as Zeiss and Goerz is more expensive than any home product. The production of such firms find a market *not on price but on quality*.

8. British firms, generally speaking, in the optical instrument trade, have not been in the front rank in the production of new models and improvements. In many sections of the industry the productions are purely imitations of goods produced either by German or American manufacturers.

Concrete instances are given.

9. In the case of imitations, it may be admitted that the British manufacturers have a difficulty in obtaining the market. Firstly, because before the imitations have been laboriously produced for the market, a period of perhaps one to two years has elapsed and the result has been that the articles imitated are no longer current models with the firms who originated them. Therefore, to other shortcomings on the part of the home manufacturer which account for his reputed unsatisfactory position at the present time, may be added lack of inventive genius and initiative.

10. Another important point in regard to the home producer is the *over-capitalisation* of many of the existing firms, and it is urged that the two largest firms in the trade, the Amalgamated Photographic Manufacturers and the British Photographic Industries, were floated in 1920 and 1921 at grossly excessive figures. The Amalgamated Photographic Manufacturers have already had to write off a sum, as loss, in excess of £400,000, and *very severe comments were made by Mr. Justice Eve* as to the financial history of this concern.

11. In Clause 6 of the Committee's Report reference was made to the key value of the optical industry for peace time requirements. It is important that industries using optical instruments should have access to the very best instruments of their class, no matter what their origin, and the increase of duties not only increases the price to the consumer but is a direct stumbling block to progress. Many optical instruments are used in connection with medical, research and hospital work. For such purposes the very best instruments must be obtained no matter what their price and as many optical instruments made in and imported from Germany have no counterpart in this country ; it simply means that institutions to whom such instruments are a necessity must pay more for them although in many cases they can ill afford extra expenditure.

12. The increasing application of science to industry makes it more than ever necessary that industries should have access without hindrance to the very best optical and scientific instruments irrespective of the country of origin. It is unfair that excessive protection should be given to a comparatively small industry at the expense of industries as a whole.

13. In regard to Clause 9 (page 6) of the Committee's Report it should be pointed out that evidence from home manufacturers only relative to goods covered by the schedule is only one side of the question.

DEALING WITH THE SPECIAL INSTRUMENTS MENTIONED BY THE COMMITTEE :

(a) *Optical Glass*—

In peace time it is absolutely impossible for the existing optical glass works to find a market for their output. Such works can only be kept going with the aid of large subsidies. It is an actual fact that one large optical glass factory could at the present time fulfil the needs of the whole world. It is also a fact that the optical glass produced by German manufacturers is of a far better quality than that produced by the home manufacturers. The fact that the home manufacturers cannot export their glass, but that the Germans can, is evidence which tends to prove that the non-producing countries still consider German glass superior. The German glass is whiter and freer from defects such as bubbles, foreign matter, stress and strain. If the British glass were, as some interested people say, better than German produced glass, an export trade would soon develop because the comparative cost of raw glass in relation to the price of a finished optical instrument is almost infinitesimal. Therefore, if British glass were of superior quality it would certainly be used all over the world in preference to German glass. As a matter of fact there is still German glass imported into this country and used by English lens manufacturers.

(b) *Optical Elements and Optical Instruments*—

Here again, the best German makes sell *not on price but on quality*. There is no doubt that amongst independent users the German prismatic binocular, microscope and photographic lens are still considered to be superior and evidence to prove this is found in the fact that they still hold the premier position in most markets of the world.

14. In regard to Clause 17. It is not true that the German home market is much larger than the home market in this country. As a matter of fact the position is much the same taking all things into consideration. Germany, it is true, has a larger population than the British Isles, but this is more than counter-balanced by the fact that the German spending power is much less than the British. Mass production methods are open to every manufacturer, be he British, French, or German, with suitable organisation.

15. The secret of producing high class instruments at an economic price is not to be found in mass production. It is in scientific skill, organisation and the ability of the workmen employed. It is extremely difficult in Great Britain to find workmen in sufficient quantities who are suited to the production of the finest class of work. That a number of such workmen do exist is not disputed, but the point is that there is a limited supply. The average British mechanician is better suited for the heavier class of engineering work than he is for the fine, intricate and somewhat tedious work which is required in optical instrument making. In this direction, national characteristics mean a great deal.

16. A considerable point seems to be made in Clause 24 and others of the fact that British manufacturers have spent money in the production of their various wares. This surely should not entitle them to excessive protection? Other and more important industries spend sums of money which make the sums spent by the optical instrument industries appear altogether insignificant.

17. In Clause 29 a special point seems to have been made of the fact that some German universities and German trades have bought British instruments. This is really not an important point. Interchange of productions in this respect is continually going on if only to find out what is being done in this country.

18. With regard to paragraphs 34 and 35. It should be pointed out in regard to photographic cameras that the main competition which the British manufacturers have to face is from the Kodak Co., which, as the Report states, imports something between 300,000 and 400,000 cameras every year. These cameras are imported from Canada, although it is not claimed that more than 25 per cent. of Empire labour enters into their construction. Beside these large imports the German cameras imported into this country are comparatively insignificant—the total value of them being not more than £20,000 to £25,000 per year at the outside. It is unfair to both German and British manufacturers that these huge imports, probably of which 75 per cent. in value are of American origin, should be allowed to come in free. The Committee recommended that the proportion of Empire labour should be increased to 75 per cent., but apparently this is not being acted upon. The camera trade is undoubtedly the most important single item in the whole of the optical instrument business and unless the so-called Canadian products are made liable to the increased duties, there can be no material assistance to the British trade.

GENERAL.

While theoretically the Safeguarding of Industries duties are not aimed against any particular country, it is a fact that, as they are at present levied, they hit Germany harder than any other country, and it is doubtful wisdom to accentuate this tendency by singling out for *increased* duties the very goods in which Germany is primarily concerned. Diplomatic feeling was created over this question last December, when there was some suggestion of appealing to the Hague Tribunal.

I do not, of course, pretend to endorse all the statements or arguments contained in this memorandum, but I quote it in order that British glass manufacturers may see what is being said in the trade. No doubt some of the criticisms made are valid. On other points there is bound to be considerable difference of opinion, and unfortunately it does not seem possible in some quarters to discuss the tariff question without introducing an element of bitterness.

Whatever the merits of the case there is little doubt that the Budget proposals will be ratified by Parliament without substantial alterations, so that the British optical glass manufacturers may count upon some years of protection at the rate of 50 per cent. It is the obvious duty of every progressive firm to make the most of this opportunity.

Merchandise Marks Bill.

The Merchandise (Imported Goods) Bill passed its Second Reading in the House of Commons on May 12th. It was rather an unfortunate day to hold the debate, since the General Strike had been called off only three hours before the President rose to move the Second Reading, and the Bill, of course, is one which requires very calm and concentrated attention. The debate languished badly and the figures on division were no sure indication of the real merits of the case. The London Chamber of Commerce and other bodies promptly urged upon the Government that the Committee Stage should be deferred until trade organisations throughout the country had had ample opportunity of collating their criticisms and placing Members of Parliament in full and considered possession of them. It is anticipated that the Committee Stage will, in fact, commence about the third week in June and it is likely to go on for some weeks, since the Bill is very comprehensive and even the supporters of the main principles of the Bill are aware of the pitfalls surrounding hasty legislation on so intricate a subject.

It must not be overlooked that in 1920 the question of Merchandise Marks was the subject of exhaustive enquiry by an important and highly competent Board of Trade Committee which sat under the chairmanship of Sir Harry Greer (then Mr. Harry Greer, M.P.) and heard evidence which was afterwards published in a blue book of 250 closely printed foolscap pages. In the case of glassware responsible witnesses urged that there were special difficulties to be met in view of the peculiar nature of the article, and this will be a point which will have to be borne carefully in mind by the Committee

[*Continued on page* 293.

April Trade Returns.

IMPORTS OF GLASS AND GLASSWARE.

		QUANTITIES.				VALUE.			
		Month ended 30th April.		Four months ended 30th April.		Month ended 30th April.		Four months ended 30th April.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod) ...	value	—	—	—	—	6,155	7,484	22,243	25,766
Glass Tubing and Rod for all purposes	cwts.	616	469	2,163	2,306	2,115	1,374	7,677	6,935
Illuminating Glassware	,,	11,342	11,299	42,846	48,757	27,657	31,606	114,078	138,549
Machinery Glassware	,,	51	3	80	22	393	34	809	252
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	50.153	54,526	180,120	201,268	138,599	149.049	492,372	555,618
Plate and Sheet Glass	,,	91,888	124,999	368.503	432,013	135,965	177,911	542,845	589,705
Optical Glass (other than worked Elements, *e.g.* Lenses)	,,	3	1	25	8	68	330	1,488	884
Bottles and Jars	gross	124,027	132,392	433,406	496,075	79,245	77,716	265,958	293.376
Glass and Glassware not elsewhere specified ...	cwts.	2,720	2,576	6,623	10,555	7,236	7,625	21,882	.28,738
Total Value	£	—	—	—	—	397,433	453,129	1,469,352	1,639,823

EXPORTS OF GLASS AND GLASSWARE (BRITISH PRODUCTS).

		QUANTITIES.				VALUE.			
		Month ended 30th April.		Four months ended 30th April.		Month ended 30th April.		Four months ended 30th April.	
		1925	1926.	1925.	1926.	1925.	1926.	1925	1926.
Scientific Glassware (except Tubing and Rod) ...	value	—	—	—	—	5,850	5,575	23,422	23,684
Tubing and Rod for all purposes...	cwts.	282	401	1,152	1,711	2,123	2,809	8,104	10,629
Illuminating Glassware	,,	692	358	2,103	1,840	5,174	4,310	19,179	17,250
Machinery Glassware	,,	325	224	1,409	884	2,356	1,749	9,713	6,570
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	2,571	2,127	10,303	8,985	22,042	20,984	89,389	88,260
Plate and Sheet	,,	64,213	61,805	260,806	310,731	122,116	105,492	519,409	546,739
Optical (other than worked Elements, *e.g.* Lenses)	,,	25	4	47	17	516	106	1,243	459
Bottles and Jars	gross	34,825	20,048	112,941	101,464	33,295	19,522	115,388	98,893
Manufactures, not elsewhere specified	cwts.	893	440	2,656	2,758	4,209	3,015	14,041	16,861
Total Value	£	—	—	—	—	197,681	163,562	799,888	809,345

EXPORTS OF GLASS AND GLASSWARE (FOREIGN AND COLONIAL MERCHANDISE).

		QUANTITIES.				VALUE.			
		Month ended 30th April.		Four months ended 30th April.		Month ended 30th April.		Four months ended 30th April.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod) ...	value	—	—	—	—	700	244	2,210	1,662
Glass Tubing and Rod for all purposes... ...	cwts.	—	1	5	8	2	6	56	91
Illuminating Glassware	,,	75	125	619	652	847	1,012	5,060	5,643
Machinery Glassware	,,	—	—	—	2	—	—	6	36
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	688	934	2,826	2,806	3.908	5,757	16,837	17,842
Plate and Sheet	,,	411	448	1,075	2,050	788	481	1,621	2,260
Optical Glass (other than worked Elements, *e.g.* Lenses)	,,	-	7	4	16	—	87	86	143
Bottles and Jars	gross	1,170	1,170	6,111	4,266	1,287	880	6,331	3,844
Glass and Glassware not elsewhere specified ...	cwts.	17	38	172	201	87	125	1,769	665
Total Value	£	—	—	—	—	7,619	8,592	33.976	32,186

United States Patents.

GRANTED APRIL 13th, 1926.

1,580,122.—**Apparatus for Making Plate Glass.** Albert E. Evans, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed June 5, 1924. Serial No. 718,037. 6 Claims. (Cl. 49—59.)

1. In combination in apparatus for handling and treating pots containing molten glass preliminary to casting the glass into plates, which comprises, a tunnel furnace having a track therethrough, a series of cars on the track for carrying the pots, a moving device for the cars extending longitudinally of the furnace, engaging means on such device adapted to engage the car next to the outlet end of the furnace and also a car located outside the entrance end of the furnace, but adjacent thereto, and means for reciprocating said device so that on the forward movement thereof, said car next the outlet end of the furnace is moved outside of and away from the furnace, and said car adjacent the entrance is moved into the furnace, thereby moving all of the other cars in the furnace ahead one car length.

6. In combination in apparatus for handling and treating pots containing molten glass preliminary to casting the glass into plates, which comprises, a tunnel furnace having a track therethrough and a passageway longitudinally of its bottom opening upwardly, a series of cars on the track for carrying the pots, a moving device for the cars extending longitudinally of the passageway, means extending upwardly from said device for engaging the cars, conduit means also extending longitudinally of the passageway, and means for circulating a cooling fluid through said conduit means.

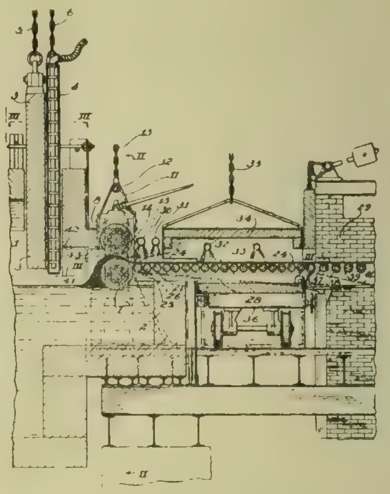
1,580,128.—**Edge-holding Device for Sheet-Glass Machines.** John H. Fox, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed May 2, 1924. Serial No. 710.569. 8 Claims. (Cl. 49—17.)

1. In combination with apparatus for drawing a glass sheet from a molten bath, means for preventing inward movement of the edge of the sheet comprising a pair of fingers spaced apart so that they will straddle the edge of the sheet, and mechanism for moving said fingers at intervals downward along the edge of the sheet and into the tapering base thereof to thin it and then back from such position along substantially the same path.

1,580,129.—**Polishing Runner.** Frederick Gelstharp, Tarentum, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed June 16, 1923. Serial No. 645,857. Renewed October 16, 1925. 4 Claims. (Cl. 51—197.)

1. In combination, a plate glass polishing runner comprising a supporting block, a sheet of polishing felt on the lower face of the block, and means for securing the felt to the block consisting of means cemented to the upper surface of the felt sheet at the edge thereof and provided with holding members extending upwardly through the block, and releasable securing means for the upper ends of said members.

1,580,130.—**Apparatus for Making Plate Glass.** Frederick Gelstharp, Tarentum, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed July 9, 1925. Serial No. 42,536. 4 Claims. (Cl. 49—33.)

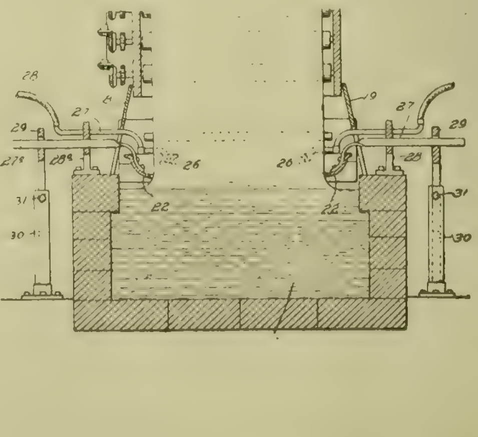


1. In combination, a glass tank having a forehearth or extension having an open top, a pair of horizontally driven and cooled sizing rolls arranged one above the other in said open top with the lower roll partially immersed in the molten glass in the forehearth, and a glass receiving bed extending laterally from a point adjacent to the pass between the rolls for carrying away the glass which is formed.

1,580,135.—**Apparatus for Maintaining the Level in Glass Tanks.** Joseph S. Gregorius, Mount Vernon, Ohio, assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed December 3, 1924, Serial No. 753,639. Renewed October 16, 1925. 6 Claims. (Cl. 49—54.)

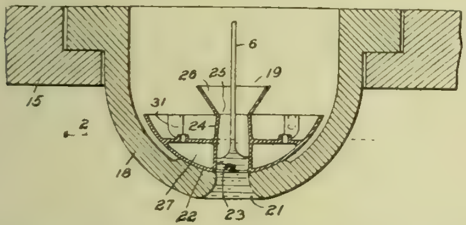
1. The combination with a glass furnace, having an observation opening in one of its walls, of a float of refractory material in position to be observed through said opening, a sighting device on the outer side of said wall in line with said opening, and means for determining the vertical position of the line of sight of such sighting device.

1,580,140.—**Apparatus for Making Sheet Glass.** Walter G. Koupal, Mount Vernon, Ohio, assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed August 12, 1925. Serial No. 49,744. 4 Claims. (Cl. 49—17.)



1. In combination with apparatus arranged to draw a glass sheet from an open pool of molten glass, of means for preventing inward movement of the edge of the sheet in said pool, comprising a shielding plate spaced above the surface of the pool, but closely adjacent thereto and having a slot extending inward from its edge and fitting round the edge of the sheet, and means for applying a cooling flow of air to the upper surface of the plate on each side of said slot.

1,580,150.—**Apparatus for Drawing Sheet Glass.** Robert A. Miller, Jr., Tarentum, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed May 9, 1923. Serial No. 637,640. Renewed October 16, 1925. 9 Claims. (Cl. 49—17.)



1. In glass drawing apparatus employing a glass bath from which a sheet of glass is to be drawn, a refractory member provided with a slot lying in the glass, a metal member having a slot portion lying in the bath above the slot in the refractory member with the sides of said slot portion, over which the sides of the glass sheet are drawn, roughened, and means for cooling the portion of the metal slot member in contact with the glass.

1,580,156.—**Process and Apparatus for Rolling Glass.** Grover C. Oakes, Creighton, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed July 9, 1925. Serial No. 42,490. 5 Claims. (Cl. 49—33.)

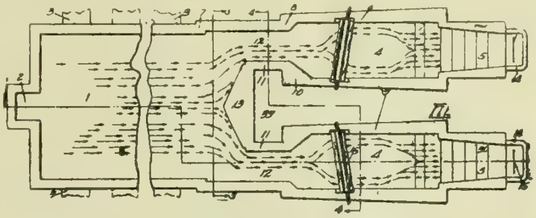
1. A process for making plate glass which consists in flowing it continuously from a body of molten glass between a pair of driven sizing rolls, and periodically separating the rolls to permit a body of glass to pass therethrough of a thickness in excess of that of the ribbon which is being produced.

1,580,287.—**Glass Substitute.** Jules Joseph Colle and Achilles Colle, Summit, N. J., assignors to Cello Products Incorporated, New York, N. Y., a Corporation of New York. Filed March 20, 1924. Serial No. 700,500. 6 Claims. (Cl. 91—68.)

5. An article of manufacture comprising a reticular metallic base covered with a flexible transparent film adapted to wet the strands of said base and follow the expansion and contraction thereof, the thickness of said film being such as to only slightly incase the top portions of the strands of said base, and the body portion of said film being substantially disposed in horizontal planes below the top of said strands.

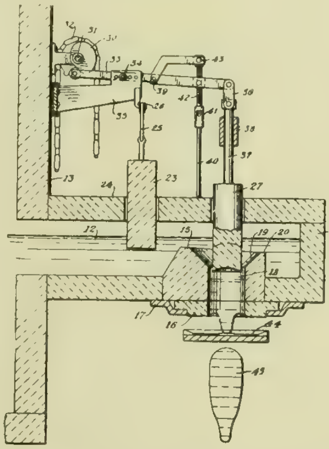
1,581,338.—**Continuous Tank Furnace.** Enoch T. Ferngren, Toledo, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed October 27, 1923. Serial No. 671,126. 14 Claims. (Cl. 49—54.)

1. A furnace for supplying molten glass to a pair of glass-working machines, comprising a melting tank, a pair of parallel refining tanks and passages connecting the discharge end of the melting tank with the receiving end of the refining tanks, the passages being narrower than the refining tanks and having their outer sides substantially in line with the outer sides of the melting and refining tanks.



8. The method of distributing heat to a pair of parallel refining tanks, which are fed from a single melting tank, consisting in having the enclosed heating space above each refining tank, which spaces are supplied with heat from the chamber above the melting tank, overlap the outer sides of the refining tanks, so that a greater portion of this heat is directed above the outer portions of these tanks, and a lesser portion of the heat above the adjacent portions of the refining tanks.

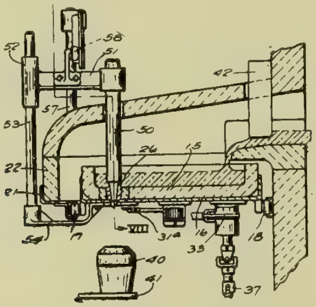
1,581,922.—**Glass Feeder.** Enoch T. Ferngren, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Filed January 23, 1924. Serial No. 689,021. 17 Claims. (Cl. 49—55.)



1. The combination of a container for molten glass, an annular member projecting upward from the floor of the container and providing an open bottomed well through which glass is discharged from the container, means for maintaining a supply of molten glass within the container with the level of the glass above the upper surface of said member, a plunger projecting downward into the well, and means to periodically reciprocate the plunger up and down.

1,581,963.—**Means for Delivering Charges of Molten Glass.** Richard La France, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Filed August 11, 1920. Serial No. 402,814. 6 Claims. (Cl. 49—55.)

3. The combination of a receptacle to contain molten glass, having a discharge outlet, means to reciprocate said receptacle horizontally, an implement extending into the glass over said outlet, means to reciprocate said implement vertically in synchronism with the horizontal movements of the receptacle and thereby control the discharge of glass, and a cutter beneath said outlet operating in synchronism with the movements of said implement to sever individual masses or charges of glass.



GRANTED APRIL 27, 1926.

1,582,132.—**Method of Controlling the Temperature of Cast Glass in the Manufacture of Sheet Glass by Vertical Drawing.** Ernest Delacuvellerie, Dampremy, Belgium, assignor to The Société Anonyme "Brevets Fourcault," Dampremy, Belgium, a Corporation of Belgium. Filed April 16, 1923. Serial No. 632,497. 3 Claims. (Cl. 49—17.)

1. The method of controlling the temperature of molten glass in the manufacture of sheet glass in glass drawing furnaces consisting in applying heat locally to the portions of the body of molten glass lying contiguous to the walls of the furnace before the glass reaches the drawing chamber of the furnace whereby to maintain the entire mass of molten glass at a uniform temperature during drawing operation.

1,582,335.—**Apparatus for Molding and Annealing Glass.** Walter G. Clark, New York, N. Y. Filed May 11, 1920. Serial No. 380,466. 16 Claims. (Cl. 49—1.)

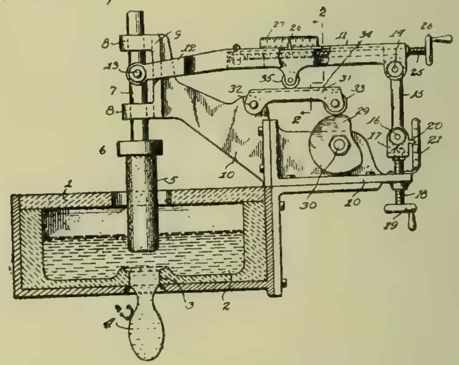
1. In combination, an annular frame rotatable on its own diameter and provided with inwardly pointing edge flanges forming an interior channel way around the frame; a combined mold and furnace body portion disposed within said frame and provided with a pair of peripheral supporting flanges together forming an outwardly opening channel; supporting rings disposed between said supporting flanges respectively and the adjacent edge flanges of the frame; rollers rotatably mounted on said rings radial thereto and engaging said flanges for rotatably supporting the body portion against movement in the direction of its axis; a series of rollers mounted on one supporting flange and engaging the frame to hold the body portion rotatably mounted co-axial with the frame; a lid portion forming with said body portion a disk shaped chamber; and means for rotating the body portion as the frame is rotated.

1,582,496. **Method and Apparatus for Annealing and Cooling Sheet Glass.** Otis A. Wells, Arnold, Pa., assignor to Window Glass Machine Company, Arnold, Pa., a Corporation of New Jersey. Filed October 17, 1924. Serial No. 744,164. 5 Claims. (Cl. 49—47.)

1. In the method of annealing and cooling sheet glass, the steps consisting in supplying flat hot glass to a horizontally extending leer, passing hot gases through the leer in streams above and below the glass and withdrawing gases over substantially the entire width of the leer intermediate the ends of the leer.

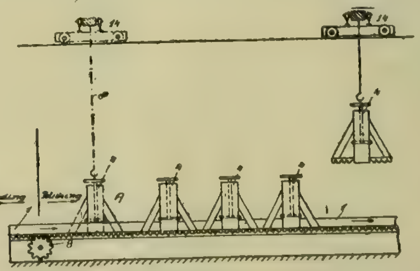
2. Apparatus for annealing and cooling sheet glass including a horizontally extending leer tunnel, means for passing sheet glass therethrough, means for introducing gaseous streams above and below the glass, and means intermediate the ends of the leer for withdrawing gases over substantially the entire width of the leer.

1,582,725.—**Glass Feeder.** Albert R. Bethel and Josiah H. Williams, Los Angeles, Calif. Filed December 29, 1924. Serial No. 758,685. 17 Claims. (Cl. 49—55.)



17. In a glass feeder, a glass discharge chamber having a discharge orifice, a reciprocatory plunger movable with relation to said orifice, a vibratory plunger actuating lever fulcrumed at one end and pivotally coupled to the plunger at its opposite end, a cam, and motion transmitting mechanism between the cam and the lever acting on the latter between its ends, said mechanism comprising a member vibrated by the cam and a member for transmitting vibratory motion from said vibratory member to the vibratory plunger actuating lever, said members being adjustable relatively to each other and to said lever for varying the vibratory motion of the latter and the stroke of the plunger.

1,582,808.—**Process of Grinding and Polishing Glass Plates.** Lambert von Reis, Herzogenrath, Germany. Filed July 14, 1925. Serial No. 43,572. 2 Claims. (Cl. 51—278.)



1. The process of grinding and polishing glass plates passing beneath a series of grinding and polishing

appliances arranged in succession to one another, which consists in imparting to the polishing appliances a movement in the direction of the feed of the glass so as to cause a vacant space to be at intervals formed between the foremost grinding appliance and the rearmost polishing appliance and inserting a polishing appliance with clean felts into the said vacant space, for the purpose of avoiding an interruption of the polishing operation.

GRANTED MAY 4, 1926.

1,583,046.—**Leer for Annealing Glassware.** Henry W. Ingle, Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed March 31, 1925. Serial No. 19,613. 13 Claims. (Cl. 49—47.)

1. A glass annealing leer comprising a tunnel having a heated floor, and an endless carrier having one side of its ware-bearing stand in direct contact with said floor and the other side thereof in direct contact with the ware.

1,583,424.—**Glass-forming Machine.** John F. Rule, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Filed September 29, 1922. Serial No. 591,238. 14 Claims. (Cl. 49—9.)

12. In a glass forming machine, the combination of a rotary mold carriage, molds thereon, a mold bottom associated with each mold, heads on which the mold bottoms are mounted, and stationary cam tracks each controlling certain of said heads and operable as each head reaches a predetermined point in its rotation with the mold carriage, to lower said head and tilt the mold bottom, each cam track operable to effect the tilting of the mold bottoms under its control independently of the other cam tracks and at a different rotative position of the molds.

1,583,428.—**Mechanism for Transferring Ware from Leers.** Leonard D. Soubier, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Filed December 15, 1922. Serial No. 607,121. 23 Claims. (Cl. 198—27.)

1. The combination of a leer, leer pans therein comprising means to hold articles in upright position on the pans, a transfer device at the discharge end of the leer, and means operable to actuate said transfer device and cause it to transfer the leer pans from the discharge end of the leer to a position external to the leer and discharge the articles from the leer pans.

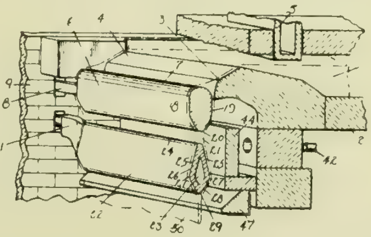
1,583,464.—**Method of Forming Glassware.** William G. Housekeeper, South Orange, N. J., assignor to Western Electric Company, Incorporated, New York, N. Y., a Corporation of New York. Filed September 13, 1924. Serial No. 737,453. 5 Claims. (Cl. 49—84.)

1. The method of forming glassware which comprises forming a core, applying a thin layer of foil to said core, pressing melted glass on said foil, removing the core, and thereafter removing the foil.

4. The method of forming glassware having exact interior dimensions which comprises forming a core of approximately the dimensions of the passage desired, applying thin metallic foil to the surface of said core, oxidising the metal foil, surrounding said core and foil with a glass vessel of slightly larger interior dimensions, fusing said glass by heat, pressing the fused glass in contact with said foil, slowly cooling said glass vessel, removing said core, and thereafter dissolving said metal foil in acid.

1,583,541.—**Forming Continuous Sheet Glass.** Enoch T. Ferngren, Toledo, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed February 25th, 1924. Serial No. 694,930. 42 Claims. (Cl. 49—17.)

8. In the art of making sheet glass, the method of handling the glass before forming the sheet which consists in delivering the glass originally as a relatively wide and shallow flow toward and over the exterior of a horizontally positioned member in a manner to divide the glass into two shallower flows proceeding downwardly on said member, in uniting said flows into a single flow beneath said member, and thereafter in again dividing and reuniting the said single flow in a similar fashion prior to the application of drawing force thereto.



1,583,542.—**Apparatus for Cutting Sheet Glass.** Enoch T. Ferngren, Toledo, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed March 31, 1924. Serial No. 703,032. 8 Claims. (Cl. 49—48.)

1. In combination with means for feeding a sheet of glass longitudinally, a sheet scoring mechanism comprising a cutter member, a cutter-carrying arm, means for holding the cutter yieldingly against the sheet, means supporting the opposite face of the sheet, and a carrier for the arm and supporting means adapted to move with the sheet at right angles to its direction of travel.

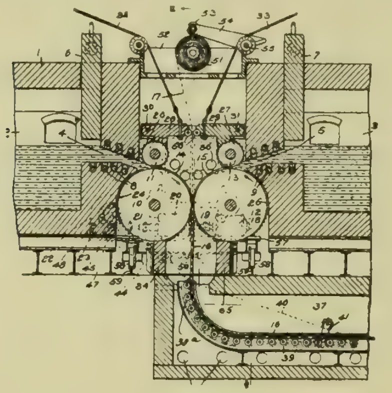
GRANTED MAY 11, 1926.

1,583,779.—**Process and Apparatus for Making Sheet Glass.** Karl L. W. Core, Ford City, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed July 9, 1925. Serial No. 42,519. 4 Claims. (Cl. 49—33.)

1. A process for making sheet glass which consists in flowing the glass from a molten bath to the pass between a pair of forming rolls, driving the rolls at the same peripheral speed, and shifting the relation of one of the rolls to its driving means to bring the rolls into parallelism in case they become bowed away from each other in service.

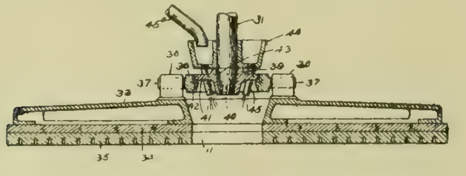
1,583,793.—**Apparatus for Making Sheet Glass.** William Owen, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of

Pennsylvania. Filed September 26, 1922. Serial No. 590,634. 4 Claims. (Cl. 49—32.)



1. In combination in apparatus for making sheet glass, a pair of opposing tank receptacles each containing a bath of molten glass, and provided with opposing lateral outlets, a pair of rolls opposite each outlet in close proximity thereto to receive the glass therefrom with the passes therebetween under the head pressure in said receptacles and with the lower members of such pairs of rolls spaced so as to provide a vertical pass therebetween adapted to receive and press together the ribbons formed between the pairs of rolls, and means for rotating at least one roll of each of said pairs of rolls.

1,583,807.—**Grinding Machine.** Jacob Soderberg, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed October 11, 1922. Serial No. 593,760. 2 Claims. (Cl. 51—110.)

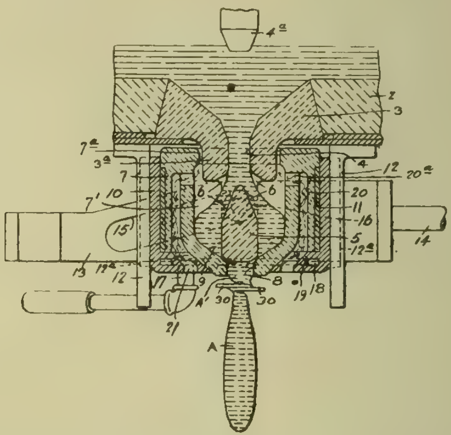


1. A grinding machine for sheet glass comprising a bed or table mounted for longitudinal movement and carrying the glass sheet to be surfaced, a plurality of horizontal grinding discs, having their centers open, arranged in two sets or series along the table with their axes of rotation off center with respect to the longitudinal center line of the table and of such diameter that each disc extends out past both of the side edges of the sheet a substantial distance, one set or series of said discs having their axes to one side of such center line, and the other set or series having their axes on the other side of such center line, but all of said axes being located inward from the side edges of the glass sheet, and means for rotating the discs.

1,583,817.—**Apparatus for Making Plate Glass.** William G. Watson, Ford City, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed August 18, 1923. Serial No. 658,174. 2 Claims. (Cl. 49—3.)

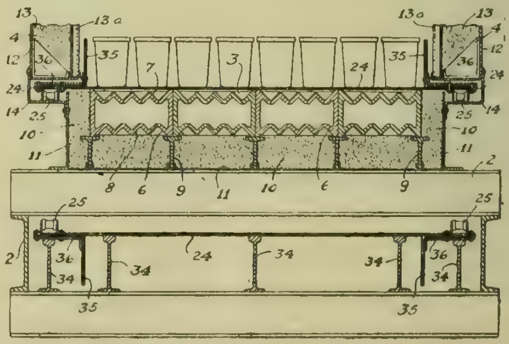
1. Apparatus for making plate glass comprising a pot melting furnace, a casting table, and a tunnel soaking kiln with its discharge end located at a point adjacent the casting table, and means for carrying the glass melting pots, containing the glass which has been melted and fined in the furnace through the kiln.

1,583,932.—**Method and Apparatus for Feeding Molten Glass.** John R. Keller, Glenshaw, Pa., assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed June 26, 1923. Serial No. 647,839. 11 Claims. (Cl. 49—55.)



2. Apparatus for feeding molten glass, comprising a container for the glass having a downwardly opening discharge outlet, means for supplying glass continuously to said outlet, a vertically reciprocable cup disposed beneath said outlet and having a discharge opening in vertical alignment with the discharge outlet of said container, a stationary post associated with said cup and having its lower end in vertical alignment with the discharge opening of said cup, the said post having passages for the discharge of glass laterally into said cup.

1,584,241.—**Apparatus for Annealing Glassware.** Vergil Mulholland, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed August 27, 1925.



Serial No. 52,752. 11 Claims. (Cl. 49—47.)

1. A glass annealing lehr comprising a tunnel having a bottom, a flexible endless conveyor having its ware-bearing strand extending through said tunnel and in contact with said bottom, a sprocket chain secured to each edge of said conveyor, and mechanism for driving said chains.

BRITISH PATENTS.

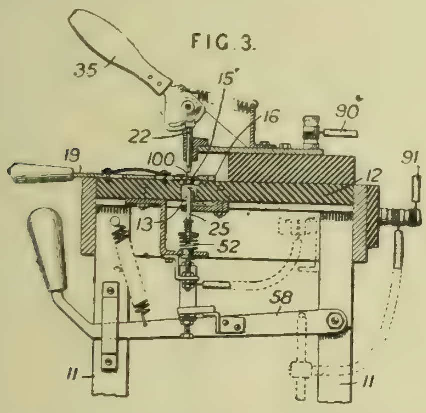
The following abstracts are taken from the Illustrated Official Journal of Patents with the special permission of the Controller of H.M. Stationery Office.

Printed copies of the full specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C., price 1/- each.

248,369.—**Making Firebricks.** Pfälzische Chamotte- und Thonwerke (Schiffer & Kircher), Akt.-Ges., Grünstadt, Rheinpfalz, Germany.—(Assignees of Wagapoff, G.; 80, Grossbeerenstrasse, Berlin.) February 22, 1926, No. 5075. Convention date, February 25, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 87 (i).)

Firebricks are made by taking refractory clay, without any admixture of lean materials, reducing the moisture content to not more than twenty per cent. by weight, disintegrating it to a size of granule varying from dust-like fineness up to 10 millimetres, mixing the various sizes of granules intimately, pouring the mixture into moulds and compressing it, then firing in the usual way.

248,403.—**Perforating Glass.** Corning Glass Works, Walnut Street, Corning, New York, U.S.A.—(Assignees of Littleton, J. T.; 31, East 5th Street, and Smith, C. R.; 87, West Erie Avenue, both in Corning, New York, U.S.A.). March 2, 1926, No. 5878. Convention date, March 2, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)



A method of perforating a glass article consists in heating the article to the temperature at which the glass will conduct electricity, and then passing a current through the body of the article so that the glass is melted by the heat resulting from the resistance it offers to the passage of the current. A device for perforating a flat piece of glass comprises a table 11 having a top 12 of insulating material, a number of electrodes 22 supported above the table, and a corresponding number of lower electrodes 25 supported in an opening 13 in the table. The upper electrodes can be raised or lowered by handles 35 and the lower electrodes can be depressed against the action of springs 52 by means of a hand lever 58. A die 15, provided with holes corresponding to the perforations required in the glass, is fitted in a recess above the opening 13. In use, a piece of glass 100, heated to the necessary temperature, is placed on the table and is pushed against stops 16 by a holder 19. The upper electrodes are now lowered into contact with the glass, the lower electrodes being held against the glass by the springs 52. The electric current from the leads 90, 91 passes through the hot glass between the electrodes and raises its temperature. When the glass is soft, the handles 35 are moved to push the upper electrodes through the glass to form the perforations, the lever 58 being moved at the same time to remove the lower electrodes. The parts of the apparatus may be suitably arranged to enable perforations to be made in cylinders or other partly enclosed vessels, or such articles as dental shields. The knobs of glass forced out by the electrodes may be formed into various shapes, such as beads, by suitably shaping the electrodes. The perforation could also be formed by using a hollow electrode and directing a jet of air through it instead of forcing the electrode itself through the glass. When large perforations are being made through thick pieces of glass, the electrodes may be separated when the current flows, so that the arc thus formed may assist in softening the glass. The operation is facilitated by the use of heat-resisting glasses such as those described in Specification 100,738.

248,678.—**Bottles.** Alexander, A. S., 372, Stanstead Road, Catford, London. November 25, 1925, No. 29762. Drawings to Specification. (Class 125 (i).)

Fittings to indicate bottles containing poisons and non-potable substances.—Medical bottles other than those containing medicine to be taken internally are provided with corks formed, on that part which projects from the bottle, with two or more prominent pointed projections cut from the substance of the cork. Specification 16513/90 is referred to.

248,460.—**Glass Manufacture.** Kephart, A. T., 8, Western Avenue, Brent, Golders Green, London. December 3, 1924. No. 29042. (Class 56.)

Forming articles from tubular blanks.—A machine for shaping the ends of tubular glass blanks, in the manufacture of phials and like receptacles, comprises means for moving a blank in a direction at right-angles to its axis from a magazine to a stationary position, means for rotating the blank in this position and for subjecting one end to a preliminary heating, means for moving the blank, in the same direction as before, to another stationary position where it is rotated and its hot end subjected to intense heating, and mechanical devices for shaping or necking the hot end. The tubes 2 are stored in an inclined magazine and they are released one at a time by gates 37, 38 which are withdrawn alternately and allow a tube to roll on to a carrier 9. The carriers are attached to parallel endless chains 10 which pass around sprocket wheels 5, 6, and the movement of the chains first conveys a tube to a position above a heating-burner 12. At this position, the tube is supported by pairs of rollers 14, 15, and a roller 13 makes contact with the tube and rotates it while one end is subjected to a prelininary heating by the burner 12. The roller 13 is inclined to the direction of movement of the tube, so that the tube end is forced against a stop 20 and is held against displacement in the direction of its axis. After the preliminary heating, the rollers 14, 15 and the roller 13 are moved apart, and the chains move the tube to the next stationary position where it is again supported by rollers 17, 18 and rotated by a roller 19 as before. In this position, the hot end of the tube is further heated by burners 21, 22. When the glass is plastic, a plug 25 moves into the end of the tube and dies 23, 24 are closed on to it, and the dies and plug together form the end of the rotating tube to the desired shape. After removal of the plug and dies, the chains 10 move again and the finished tube is discharged from the machine.

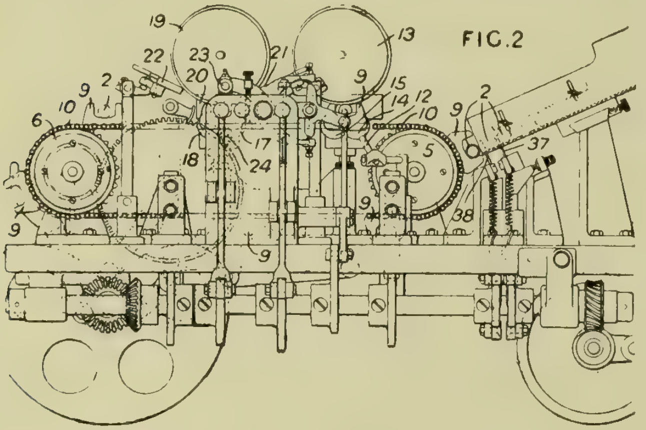


FIG. 2.

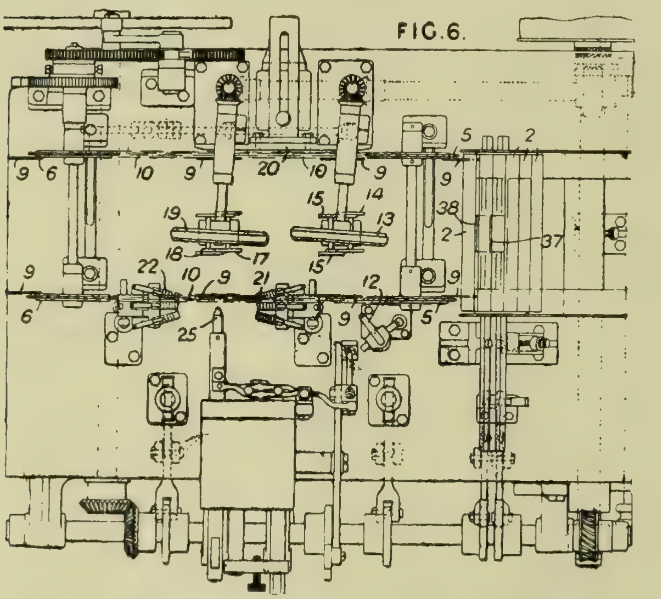


FIG. 6.

248,934.—**Electric Insulators ; Glass Manufacture.** Haddan, R., 31, Bedford Street, Strand, London.—(Corning Glass Works ; Walnut Street, Corning, New York, U.S.A.) March 30, 1925, No. 8483. (Classes 36 and 56.)

A method of making a high tension electric insulator of the kind having an embedded suspension pin, consists in pressing the pin into plastic insulating material to embed it therein, and then moving the pin relatively to the material to form a space between them.

Insulators.—The insulator comprises a body A, Fig. 4, of some suitable insulating material, which may be bakelite or the like, but is preferably a low-expansion glass, such as the glasses described in Specification 100,738. It has a skirt B, with depending petticoats C, and a knob D of which the lower portion *d* is bevelled inwardly to provide a neck portion E. A cap G fits over the knob D, and screws on to a ring K which is made in two semicircular parts that fit around the neck E. A gasket L, of cork or other suitable material, is inserted between the cap and the top of the knob D, and a gasket M of lead, solder, or other soft material is interposed between the ring K and the bevelled portion of the knob. The suspension pin N comprises a head P having a depending shank *p* which is screwed into a lower part R. The head is preferably of conical shape, but it may be of other shapes so long as the head is larger than the opening in that part of the insulator surrounding the pin. A gasket U of lead or solder is interposed between the head and the insulator to cushion the head and to distribute the load. The pin may also be made in one piece.

FIG. 1.

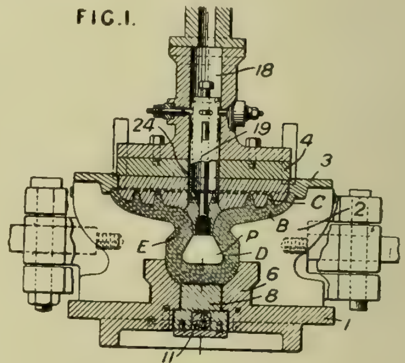
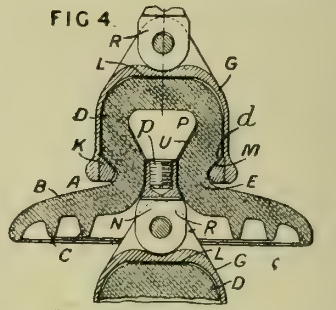


FIG. 4.



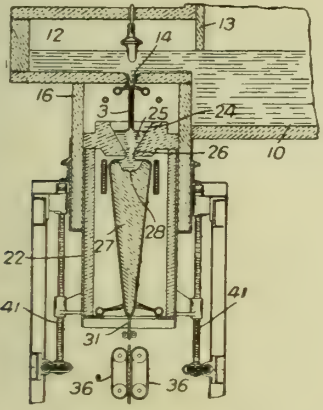
Pressing.—A device for making the insulators of glass comprises a pressing-plunger 4, Fig. 1, and a mould having a two part body 2, a base 1, and a removable ring plate 3. The base has an upstanding boss 6, which is bored axially to receive a valve 8 that can be raised or lowered slightly by means of an eccentric 11. The plunger 4 has an axial bore 18 containing a carrier 19 into the lower end of which the head P of the suspension pin is screwed. After the insulator has been pressed, a rod 24 is turned to detach the pin P, and the plunger is lifted. The mould is then covered by a jig somewhat similar in construction to the plunger. The cam 11 is turned to lower the valve 8, and the pin P is pressed farther into the glass, the movement of the valve 8 leaving space for the movement of the glass. After removal of the jig, the pin P is left embedded in the glass, but spaced from the sides of the cavity. Molten lead or solder is poured around the pin, after the glass has been annealed, to form the gasket U, Fig. 4.

248,943.—**Glass Manufacture.** Marks, E. C. R., 57, Lincoln's Inn Fields, London.—(Libbey-Owens

Sheet Glass Co.; Toledo, Ohio, U.S.A.) April 8, 1925, No. 9408. (Class 56.)

Drawing.—Relates to the method of making sheet glass in which molten glass flows on to the top of a wedge-shape slab and then runs down the sides of the slab in two streams which unite at the lower edge to form a sheet. According to the invention, the casing containing the slab is adjustable to or from the outlet in the tank furnace in order to control the amount of glass drawn from the tank. The glass is melted in a tank furnace 10, and flows to a shallow refining-end 12 whence it passes through an aperture 14 in a stream 3.

FIG. I.



The outlet 14 is surrounded by a casing 16 that forms a heating-chamber, and a second casing 22 telescopes within the casing 16, and is moved vertically by means of screws 41. A hopper 24 is mounted at the upper end of the casing 22, and the sheet-forming slab 27 is mounted below a distributing-slot 26 at the lower end of the hopper. The stream 3 of glass flows into the hopper and forms a pool 25, whence it flows through the slot 26 into a trough 28 formed on the upper edge of the slab. The glass then flows down the sides of the slab and forms a sheet 31 which is drawn away by suitable drawing-apparatus 36. By moving the casing 22 vertically, the mass of the portion of the sheet 31 suspended from the slab 27 can be altered, and the drawing-force is correspondingly altered. The amount of glass flowing into the pool 25 is controlled by raising or lowering a gate 13. The lower edge of the slab, instead of being straight may be curved so that the glass flowing into the central portion of the sheet remains on the slab longer than that which flows into the edges of the sheet. The upper edge of the slab may also extend through the slot 26 into the hopper. In another construction, a passage may extend from the trough 28 downwards through the body of the slab so that a portion of the glass will flow through the passage and join the streams flowing over the sides. Electric heating-elements may be embedded in the slab to enable the temperature of the streams of glass to be regulated. The slot 26 may have metallic lining members, the lower edges of which are flared outwardly to prevent the formation of dog metal along the side walls of the slot.

249,122.—**Silvering Mirrors, &c.** Metallique Spolecnost S.R.O. Podniky Pro Pokovovani and Dural Zrcadleni a Pokovovani Skla Kommand, Spol, Epstein & Spol, Prague. March 10, 1926, No. 6700. Convention date, March 11, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 93.)

In the production of specula, mirrors, and like reflecting devices, a layer of water glass is applied between the reflecting layer and the usual protective metallic coating. A suitable composition comprises water glass, caustic potash lye and water, the composition being boiled before application.

249,152.—**Furnaces.** Kignell, E. H., Faymoreau-les-Mines, Vendee, France, and Kignell, E. P., 118, Valhallavagen, Stockholm. March 12, 1926, No. 6947. (Convention date, March 14, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 51 (i).)

FIG. I.

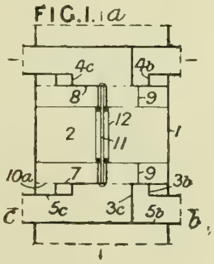
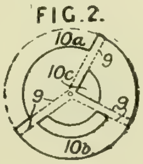


FIG. 2.



Regenerators having the regenerating material or filling with passages therethrough terminating at two ends of the filling, are provided at each of these ends with rotating valve devices adapted to conduct different fluids alternately through the same passages of the material. As shown adapted for three different fluids, the apparatus comprises a casing 1 through which passes one fluid *a* and which contains the regenerating material 2; arranged within this casing are an annular inlet 3*b* for a second fluid *b* supplied through a lateral pipe 5*b*, and a central circular inlet 3*c* for the third fluid *c* supplied through a lateral pipe 5*c*. Corresponding outlets 4*b*, 4*c* are provided, and the inlets and outlets are governed by rotary valve discs 7, 8, having openings 10*a*, 10*b*, 10*c*, Fig. 2, for the three fluids *a*, *b* and *c* respectively. Attached to the discs 7, 8 are radial plates 9 separating the openings and bearing against the regenerating material 2, and the discs are secured to a shaft 11 journaled in a central pipe 12 so that when the discs are rotated each part of the regenerating material will in turn be passed by the different fluids. Preferably the discs are given a slow continuous rotation, as by providing vanes in the openings so that the discs are rotated by the fluids passing through the apparatus, or they may be driven from pumps, fans, etc., used to force the fluids through the apparatus. The regenerating material may consist of metal, glass, brick, etc., and may have the shape of plane or corrugated plates, pipes, balls, etc. The passages in the regenerative material may or may not be axial, and the openings in the two valve discs may be different in size, shape and position. A modification is described adapted for two gases, in which fans with adjustable blades are arranged within the casing 1, the valve discs are provided with sealing strips, and perforated pipes supplying compressed air or steam for cleaning are arranged within the regenerating material.

Latest British Patents.

Applications for Patents.

10189—April 19, 1926. (January 15.) L. Rainchon. Ash-pans for gas-producer furnaces.
10228—April 19, 1926. J. B. Sanders. Non-refillable bottle.
10412—April 20, 1926. (Germany April 3, 1925.) Netallwerk Wasungen Ges. Closing devices for bottles.
10432—April 20, 1926. J. D. Mitchell. Closures for jars, etc.
10488—April 21, 1926. F. Umpleby. Gas-generators.
10523—April 21, 1926. G. Wauderlich & Co. W. Linder. Regenerative furnaces, etc.
10853—April 24, 1926. F. R. Lang. Closures for bottles.
10920—April 26, 1926. A. A. Lamberti. Oil-gas burner.
11014—April 26, 1926. G. E. Hider. Steam, etc., gas blowers for gas producers.
11164—April 28, 1926. (Germany, May 4, 1925.) F. Riechers. Manufacture of plate glass.
11360—April 30, 1926. W. J. W. Lumbard. R. Phillips. Lid for bottle.
11428—April 30, 1926. J. Askey. H. C. Wallis. Means for securing cap closures on bottles, etc.
11458—April 30, 1926. K. A. Robinson. H. C. Wallis. Cap closures for bottles, etc.
11472—May 1, 1926. G. W. Parker. Non-refillable bottle.
11600—May 3, 1926. (Germany, June 11, 1925.) M. Bicheroux. Manufacture of plate glass.
11640—May 3, 1926. N. Swindin. Siphons.
11699—May 4, 1926. (France, March 3.) Soc. Anon. d'Etudes et de Constructions Mecaniques pour la Verrerie. Process of collecting glass by suction.
11707—May 4, 1926. (E. H. Binns, R. H. Binns.) Flexible closures or fasteners.
11792—May 5, 1926. (E. H. Binns, R. H. Binns.) Flexible closures, etc.
11883—May 7, 1926. H. E. Smith. Recuperative apparatus.
11946—May 7, 1926. H. N. Cox. Optical adjusting devices.
12084—May 10, 1926. P. Brotherhood, Ltd. Utilising combustible, etc. gases.
12331—May 13, 1926. J. K. Fraser. Gas scrubbing and washing apparatus.
12434—May 14, 1926. C. F. Kenworthy. Annealing, etc., furnaces.

Specifications Published.

228924—February 7, 1924. E. Roucka. Furnaces.
231192—March 21, 1924. A. Sandberg. Regenerative preheaters for air and other media.
241184—October 13, 1924. Chemische Fabrik Griesheim-Elektron. Process for the production of practically iron-free alumina.
244391—December 10, 1924. United States Metals Refining Co. Refractories, and method of making same.
245071—December 27, 1924. A. L. Andersson. Combined bottling, corking, and labelling machine.
248403—March 2, 1925. Corning Glass Works. Perforating glass.
249461—March 23, 1925. P. Rostaing. Apparatus for finishing glass or like articles on a grinding wheel.
250659—January 14, 1925. C. E. Schmunk. Moulds for use in the Manufacture of glassware and the like.
250664—January 15, 1925. C. H. Rankin. Mechanically operated glass-feeding apparatus.
250793—June 30, 1925. (Cognate Application, 23924/25.) W. R. Parker. Stoppers or closures for bottles and other receptacles or containers.
250794—June 30, 1925. E. C. R. Marks. (E. Danner.) Manufacture of reinforced sheet glass.
250826—September 23, 1925. E. C. R. Marks. (American Machine and Foundry Co.) Plastic cap for bottles and other containers and method of making same.
251027—January 26, 1925. (Cognate Application 11457/25). M. Astafiev. Optical systems.
251072—March 21, 1925. A. .E White. (Pittsburgh Plate Glass Co.) Apparatus for surfacing glass and the like.
251138—June 20, 1925. W. E. Evans. (Europischer Verband der Flaschenfabriken Ges.) Machines for the manufacture of glass hollow-ware.
251158—August 20, 1925. W. J. Tennant. (L. V. Lockwood,) Bottle making machines.
251167—March 19, 1925. R. Urmston. Syphons or containers for soda water and the like.
251501—August 20, 1925. W. J. Tennant. (L. V. Lockwood,) Machines for making glass bottles or similar containers.
251540—June 25, 1925. J. Muchka. Air-heaters working on the regenerative principle.
251745—March 27, 1925. W. A. Woodrow. Bottles.

Specifications Open to Public Inspection.

251276—April 24, 1925. Mettallwerk Wasungen Ges. Closing devices for bottles.
251632—May 4, 1925. F. Reichers. Methods and plants for manufacturing plate glass.
251951—May 11, 1925. Naamlooze Vennootschap Philips' Gloeilampenfabrieken. Sealing metal in or to glass.

Patents, Trade Marks, Inventions.—Advice, Handbook and Consulsations free. King's Patent Agency, Ltd., Director B. T. King, C.I.M.E.; Regd. Patent Agent, G.B., U.S., and Canada, 146a, Queen Victoria Street, E.C.4, and 6, Quality Court (near Patent Office), London, W.C. 39 years' references. 'Phone: Cent. 682.

GLASS RESEARCH ASSOCIATION.

Wanted, Copies of Nos. 1 and 12 of the Glass Research Association Bulletins. Box 306, Glass Publications, Ltd.

Kapella Limited, of Leicester, England, having acquired numerous patents (British and Foreign) on machinery and appliances for sawing and grinding glass, cutting discs, and mounting, grinding and polishing lenses, are prepared to pay the sum of £50 (Fifty pounds) to anyone who may give them satisfactory evidence of any infringement of such patents. These patents are open to be licensed to responsible manufacturers.

Patents and Designs Acts, 1907 and 1919.—The Proprietors of British Patent No. 181308 are prepared to sell the patent or to licence British Manufacturers to work thereunder. It relates to an improved process of and apparatus for cooling hollow glass articles during drawing. Address: B.W. & T., 112, Hatton Garden, London, E.C.1.

The Proprietors of Letters Patent No. 199375 relating to improvements in Screw Closures for Glass Containers, desire to dispose of their Patent or to grant licences to interested parties on reasonable terms for the purpose of exploiting the same and ensuring its full commercial development and practical working in this country.

Enquiries to be addressed to CRUICKSHANK & FAIRWEATHER, Chartered Patent Agents, 65-66, Chancery Lane, London, W.C.2.

Vitreous Enamel Colours.
Stains for Glass.
Oxides for Colouring Glass Metal.
Selenium Metal.
Selenate and Selenite of Soda.

GROUND BONE, FELSPAR, FLINT, FLUORSPAR, QUARTZ, STONE, WHITING, ETC.,
CARBONATE & SULPHATE OF BARYTES
OXIDES OF ANTIMONY, ARSENIC, CHROME, COBALT, SMALTS, COPPER, IRON, MANGANESE, NICKEL, TIN, TITANIUM, URANIUM, ZINC, ETC.
TRADE MARK
CERAMIC
WENGERS, LTD.
CERAMIC COLOURS & CHEMICALS
ETRURIA,
STOKE-ON-TRENT.
England.
Samples & Price Lists Sent on Demand
COLOURS FOR POTTERS, GLAZED BRICK MANUFACTURERS, & GLASSMAKERS.
PREPARED ENAMELS FOR CAST & SHEET IRON, COPPER & JEWELLERY.

Limespar.
Phosphate of Lime.
Nitrate of Soda.
Nitrate of Potash.
Opavetro for Opacifying Glass.
Alumina, Oxide and Hydrate.

GLASS

THE RECOGNIZED ORGAN OF THE GLASS INDUSTRY
Published on the Tenth of Each Month.

Single Copies - - - - One Shilling
Annual Subscription - - 10/6 post free

GLASS PUBLICATIONS Ltd.
TECHNICAL PUBLISHERS,
Talbot House,
Arundel Street,
Strand, London, W.C.2.
Telephone: CENTRAL 5985.

CONTENTS.

	PAGE
Editorial Notes	311
Practical Notes on the Thermal Endurance of Glasses.—By H. V. E. Renn	312
The Testing of Milk Bottles and the effect of Design of the Bottle Head upon Breakage	317
The Society of Glass Technology	321
The Use of Compressed Air (Continued).—By Robert Wilson	325
A New Glass Stone: $Na_2O.3CaO.6SiO_2$.—By Albert B. Peck	329
Trade Notes	331
Glass-Making in Ancient Egypt.—By James H. Gardiner, F.Inst.P., F.C.S.	335
Optical Society	337
Books Received	338
A New Glass	339
Catalogues	340
A New Type of " Union "	340
The Trade in Parliament.—By our City Correspondent	341
The Pottery and Glass Trades' Benevolent Institution	342
May Trade Returns	343
United States Patents	344
British Patents	346
Latest British Patents	352

Editorial Notes.

It is to be feared that in innumerable instances the preparation of statistics is regarded as a sheer waste of time and energy, and unfortunately it must be admitted that a lot of work of this nature is done for which it is difficult to attribute any value to the results obtainable from the information thus collected.

Nevertheless it is safe to say that properly prepared statistics and the facts obtainable from an intelligent interpretation of what they show, have become an absolute necessity to all modern commercial organisations. In the works the engineer or works manager has the records of his instruments and meters, production charts, etc., to assist and guide him in the control of productive operations. In exactly the same way the commercial department, if it is to guide the affairs of the organisation along sound commercial lines, is dependent upon an adequate supply of figures, facts and data relative to the industry as a whole. In other words, they give the same service to the business executive as the map gives to the traveller or explorer.

It will therefore be obvious that in order to be of use and not a danger it is essential they should be correct, otherwise decisions may be arrived at and operations carried out which, instead of helping the organisation along the right lines, can just as easily have the opposite effect. They must also be as complete as possible and to this end it is necessary that everyone should co-operate to the best of their ability.

This was a subject which was particularly emphasized with reference to the glass industry by Mr. W. H. Boshart, the President and General Manager of the Owens Bottle Co., in an address he gave at the recent Annual Conference of the Glass Container Association. The title of his address was: " Facts Should Govern our Industry," and after mentioning that the productive capacity of the American glass container factories was at least 30 per cent. in excess of the normal demands of the country, stated that his company had decided to reduce production accordingly. This decision was arrived at after careful analysis and consideration of the facts brought out by the periodical reports and statistics issued by the Association, which in turn were compiled from returns made by the manufacturers themselves. Mr. Boshart laid special emphasis on the value and importance of these reports as by their assistance the manufacturer was able to gauge and control his own procedure in accordance with the general trend of the industry as a whole, and thus avoid the general chaos which would result if this co-relationship was not possible and each manufacturer struck out on his own without any reference to the influence of his actions on the industry.

This policy of collective reports is much more prevalent and advanced in America than appears to be the case in this country, but in the recent report entitled, " The Facts of Industry," the question is dealt with very fully in its application to British trade. The report has been prepared by a Committee which included some of the leading economists, three of the chief officials of the largest trade unions, and three large employers of labour.

The question of statistics and economic data are considered from another aspect, that is, that their publication would possibly assist in establishing a better feeling amongst the workpeople if they had the full economic situation put before them, and also be of assistance to industry generally in connection with the very vexed question of over-production, booms and slumps.

The report does not claim to give a cure for all our industrial troubles, but gives a clear explanation of what might be done to help. Details are also given of what is being accomplished in this direction in America, and a careful study of the Committee's opinion would be of interest and value to all manufacturers.

[GLASS *will deal with all matters pertaining to the industry in an impartial manner, consequently the Editor does not necessarily associate himself with the opinions expressed by his contributors.*]

Practical Notes on the Thermal Endurance of Glasses.

By H. V. E. RENN.

In a previous article upon thermal endurance, the property discussed was the tensile strength of different types of glass. A few remarks will now be made upon the resistance of glass to compression.

The earlier investigators upon the subject made no attempt to examine the relationship between chemical composition and compressive strength, so that little information is given regarding the general constitution of the glasses examined. In experiments carried out by Kowalski,[*] rods of glass were placed between two copper plates and steady pressure applied until fracture occurred parallel to the direction of the pressure. The maximum for fourteen experiments was 42.063 kg/mm², while the mean was as low as 37.7 kg/mm². These results were criticised by Winkelmann and Schott, who later investigated the crushing strength of various types of glass. They suggested that the smallness of Kowalski's values was in all probability due to the fact that the pressure should have been applied until complete disintegration occurred.

Table I.

Glass No.	Composition Per Cent.									Resistance to crushing kg/mm²
	SiO_2	B_2O_3	ZnO	PbO	Al_2O_3	BaO	Na_2O	K_2O	CaO	
19 = 5	71.0	14.0	—	—	5.0	—	10.0	—	—	126.4
20	20.0	—	—	80.0	—	—	—	—	—	60.6
25	70.6	—	12.0	—	—	—	17.0	—	—	97.8
26	41.0	—	—	51.7	—	—	—	7.0	—	84.3
28	64.6	2.7	2.0	—	—	10.2	5.0	15.0	—	91.6
29 = 8	67.9	—	5.8	8.1	1.0	—	16.8	—	—	99.0
30 = 10	58.7	—	—	—	—	—	—	33.0	8.0	68.3
32	54.8	—	17.0	—	—	—	—	28.0	—	73.9
33	29.3	—	—	67.5	—	—	—	3.0	—	67.3
35 = 7	73.8	—	5.0	—	3.5	—	10.5	—	7.0	112.9

The investigations of Winkelmann and Schott[†] extended to seventeen glasses. The specimens used in the tests were approximately cubes of 6 mm. edge, which were placed between two metal plates, pressure being applied until the cubes completely disintegrated. A press filled with oil supplied the necessary force, the pressure being increased gradually by screwing down a plunger. The final fracture was stated by the investigators to have occurred suddenly with explosive violence accompanied by a flash of light. Experiments carried out with plates made from different metals showed that the hardness of the metal used greatly influenced the results. Hardened steel plates 5 cm. square by 1.5 cm. thick, ground smooth and level, were finally adopted, but even with these plates superficial depressions were produced that were found to affect the final values. The results obtained with ten of the glasses are reproduced in Table I, together with the chemical composition. The numbers in the first column are those found in Winkelmann and Schott's list of 72 glasses.

Some investigations upon the resistance of glass to compression were carried out comparatively recently by Berndt,[*] who used a method similar to that employed by Winkelmann and Schott. The specimens were originally cubes of 5, 8, 10, and 15 mm. edge, but during the experiments it was found that the effective area of pressure was a circle and that cylinders of 5 mm. diameter and height withstood the same pressure as a cube of 5 mm. edge. Thus, in many of the tests, cylinders replaced the usual cubes. The specimen under examination was placed between steel plates previously hardened and polished, and the pressure gradually applied until the glass burst. A hydraulic press was used similar in principle to that employed in Winkelmann and Schott's experiments.

The results obtained by using cubes of varying size show a gradual decrease in resistance with an increase of section, as indicated in Table II.

This was not in accordance with the observations of Winkelmann and Schott, who found that in the case of glass No. 19 (Table I) a cube of 4—5 mm. edge was able to stand a mean pressure of 115.3 kg/mm², whereas with a cube of 6 mm. edge, the resistance was 126.4 kg/mm².

---

[*] Ann. d. Phys. u. Chem., 36, 307.

[†] Ann. d. Phys. u. Chem., 51, 720.

[*] Verh. d. D. Phys. Geseil, 1917, 19, 314.

Berndt pointed out that the glass examined must be homogeneous and well annealed and illustrated the effect of annealing by tests upon strained and annealed specimens. The former showed a mean resistance of 150 kg/mm², while the value for the annealed specimen was 142 kg/mm².

Table II.

Length of edge.	Pressure kg/mm².	
	Mean of several values.	Maximum value.
5 mm.	120	130
8	103	104
10	90	100
15	87	88

Calculation of Resistance to Compression.

The attempt was made by Winkelmann and Schott to express the resistance to compression in terms of the percentage analyses as in the case of the other properties discussed in previous articles. The factor assigned to an oxide was determined as that fraction of the total resistance which is contributed by each 1 per cent. of the oxide. The factors are given in Table III.

Table III.

SiO_2	1.23	Al_2O_3	1.0
B_2O_3	0.9	BaO	0.05
ZnO	0.6	Na_2O	0.02
PbO	0.48	K_2O	0.05
MgO	1.1	CaO	0.2

The values for the resistance to compression of the 10 glasses given in Table I, calculated by means of the above factors, show an average difference of approximately 6 per cent. when compared with the values found by experiment. The calculated and observed values are set out in Table IV.

Table IV.

Glass No.	Resistance to compression kg/mm².		Difference a — b
	Observed (a)	Calculated (b)	
19 = 5	126.4	110.9	+ 12%
20	60.6	63.0	— 4
25	97.8	104.6	— 7
26	84.3	75.8	+ 10
28	91.6	93.7	— 2
29 = 8	99.0	102.3	— 3
30 = 10	68.3	75.7	— 11
32	73.9	79.2	— 7
33	67.3	68.8	— 2
35 = 7	112.9	105.2	+ 7

Buchanan* made some interesting investigations upon the compressibility of solids, including glass. The method used in the test was evolved during previous observations by the same writer upon the compressibility of water, sea-water, and mercury, when it was found necessary to devise a piezometer which should contain no liquid. The work was of such an interesting nature that a short account of it will now be given. The idea occurred to construct a piezometer entirely from glass. A glass tube 50 cm. in length, of narrow bore, was graduated in millimetres, and a fine drawn-out thread of the same glass passed into the bore until it appeared at the other end. This extremity of the tube was then sealed and the end of the thread fused into it. By this means longitudinal motion of the thread was prevented, although it was otherwise free throughout its whole length. The thread was three centimetres shorter than the outside tube and in the empty space was inserted the magnetic index of a deep-sea thermometer, this end of the tube then being sealed. A piezometer was thus obtained in which the contents, being of the same material as the envelope, were completely protected from pressure, and in which the whole of the change in length due to compression fell to the envelope.

During the descent to the sea bottom, the temperature of the glass, both inside and outside, fell with that of the water, but as the contraction was the same upon all parts of the piezometer, there was no differential effect to be recorded by the index. As the instrument descended, however, the increasing pressure had the effect of shortening the outside tube, while the inner thread supporting the index remained unaffected. In this manner the tube was obliged to move past the index. When the instrument was being recovered the reverse process took place; the tube lengthened and lifted the index clear of the supporting thread by an amount equal to its previous shortening. The extent of this movement formed the basis of Buchanan's calculations.

The principle of the piezometer just described was embodied in an instrument of precision to be used in the laboratory for determining the compressibility of solids, including glass. In the modified form of the instrument the pressure was obtained by means of a force pump. A rod or wire of the substance examined was enclosed in a steel tube, the ends of which were then closed with stout glass tubes kept in position by open steel caps. Above each of the tubes was placed a microscope with a verified micrometer eye-piece, in order to observe and measure the expansion of the substance under examination when the pressure was relieved. As the compressibility of solids is very small, the highest pressures were used which were found to be compatible with the resistance of the glass end-pieces situated under the microscopes. The usual pressure was in the neighbourhood of 200 atmospheres (3,000 lbs.), as very few of the glass end-pieces were able to stand pressures in excess of 300 (4,500 lbs.) atmospheres.

The movements of the two ends of the rod or wire were ascertained from the micrometer scale and the pressure observed from a mercurial manometer. The measurements were then reduced separately to their absolute values in terms of the inch and their algebraic sum divided by the length of the test piece in inches and by the pressure in atmospheres. This gave the linear compressibility of the substance, the cubic value being three times the linear in cases of truly isotropic substances.

---

* Proc. Roy. Soc. 1904, 73, 296.

Unfortunately Buchanan did not state the composition of the glasses examined so that the above account is interesting only in that it presents a novel method of determining the compressibility of solids. The results given below in Table V refer to the compressibility per unit length and volume, per atmosphere pressure, multiplied by 10^6.

Table V.

Glass.	Density.	Compressibility.	
		Linear.	Cubic.
English lead-flint . .	—	0.973	2.92
Ditto	2.968	1.02	3.06
German tube . .	2.494	0.486	2.54

Hardness.

Hardness and the properties associated with it can appropriately be included in the present subject, although they are not strictly regarded as factors that directly influence thermal endurance.

The most important investigations upon the hardness of glass are undoubtedly those of Auerbach and the experimental confirmation and extension of the theory by Hertz. The work was the subject of numerous papers, full reference to which is given by Hovestadt*, who made a comprehensive summary of the complete investigations. Auerbach examined 14 glasses of varying composition by the method of pressing a lens upwards against a horizontally disposed glass plate by means of levers, the surface of contact being observed from above by the aid of a microscope fitted with a micrometer eye-piece. Measurements are made of the diameter of the circle of contact and the amount of mutual pressure of the lens and plate. From these data is calculated the Indentation Modulus. If the pressure is carefully increased a point will be reached when fracture occurs, usually taking the form of a circle and exceeding the area of contact by about 19 per cent. The resistance of the material to fracture by indentation is referred to by Hovestadt as the Fracture Modulus.

Table VI.

Glass No.	Composition Per Cent.										E′	F′	H
	SiO_2	B_2O_3	ZnO	PbO	Al_2O_3	BaO	Na_2O	K_2O	CaO	P_2O_5	kg/mm^2	kg/mm	$kg/mm^{5/3}$
1	69.0	2.5	—	—	—	—	4.0	16.0	8.0	—	7107	4.5	223
2	29.3	—	—	67.5	—	—	—	3.0	—	—	5871	5.6	210
3	70.25	10.0	—	—	—	—	10.0	9.5	—	—	7869	5.0	246
4	20.0	—	—	80.0	—	—	—	—	—	—	5588	4.1	183
5	71.0	14.0	—	—	5.0	—	10.0	—	—	—	7599	7.4	274
6	70.6	—	12.0	—	—	—	17.0	—	—	—	6796	9.0	272
7	34.5	10.1	7.8	—	5.0	42.0	—	—	—	—	8192	9.7	316
8	—	69.1	—	—	18.0	4.7	8.0	—	—	—	4975	8.8	219
9	32.7	31.0	—	25.0	7.0	—	1.0	3.0	—	—	5677	9.3	244
10	41.0	—	—	51.7	—	—	—	7.0	—	—	5953	3.0	173
11*	—	—	—	—	—	—	—	—	—	—	7532	6.9	267
12	67.3	2.0	7.0	—	2.5	—	14.0	—	7.0	—	7792	6.4	266
13	58.7	—	—	—	—	—	—	33.0	8.0	—	6197	11.6	278
14	—	3.0	—	—	8.0	28.0	—	—	—	59.5	6811	4.6	217

* So-called Geräteglas (laboratory glass).

The relation of the Indentation Modulus, E′, and the Fracture Modulus, F′, to the property expressed by the term hardness is defined by the equation.

$$H = \frac{1}{\pi} \sqrt[3]{\frac{3}{2} E'^2 F'}.$$

Values for E′ and F′ obtained by Auerbach and the values (in round numbers) for the property of hardness, H, determined by aid of the above equation, are set out in Table VI, together with the composition of the 14 glasses examined.

Auerbach attempted to express the absolute hardness of glass in terms of the percentage analyses and assigned factors to the constituent oxides as in the case of the other properties of glass. The following is a list of the factors :—

Table VII.

SiO_2	. .	3.32	BaO	. .	1.95
B_2O_3	. .	0.75	Na_2O	. .	—2.65
ZnO	. .	7.1	K_2O	. .	3.9
PbO	. .	1.45	CaO	. .	—6.3
Al_2O_3	. .	10.2	P_2O_5	. .	1.32

---

* Jena Glass (trans. by J. D. and A. Everett).

It was pointed out by the same writer that the factors 3.32 for SiO_2 and 10.1 for Al_2O_3, when multiplied by 100, are in close agreement with the hardness of quartz and corundum as determined by him when investigating the hardness of the minerals of Mohs' scale. The value obtained for quartz in the direction of the axis was 308 and that for corundum in the same direction, 1150. The last figure is the maximum, the mean being about 100 units less, which leads to a still closer agreement.

The hardness of the fourteen glasses examined by Auerbach calculated by aid of the factors given in Table VII are compared with the experimental values in Table VIII.

Table VIII.

Glass No.	Co-efficient of Absolute Hardness.		
	Observed (a)	Calculated (b)	a — b.
1	223	232	— 4%
2	210	207	+ 1
3	246	251	— 2
4	183	182	+ 1
5	274	270	+ 1
6	272	275	— 1
7	316	310	+ 2
8	219	222	— 1
9	244	248	— 2
10	173	238	– 38
11	267	—	—
12	266	219	+18
13	278	273	+ 2
14	217	216	+ 0

The differences are somewhat large in the case of glasses Nos. 10 and 12, but neglecting these, a fairly close agreement is observed.

Some investigations upon the hardness of glass were carried out by Lecrenier.* He adopted a method similar in principle to that of Auerbach, a sphere of sandstone being pressed into a block of the glass under examination. Measurements were made of the surface of contact and the pressure, the hardness being calculated from these data. Care was taken that the samples of glass examined were entirely free from strain, while superficial imperfections were removed by grinding and polishing.

As a result of his investigations, Lecrenier concluded that the influence of the chemical constitution of the glass on the hardness can be summarised as follows :—(1) Soda glasses are, as a rule, harder than potash glasses containing an equal volume of silica. (2) With the pure soda-lime glasses, the hardness increases with the increase of lime and decrease of soda. (3) Boric oxide imparts great hardness to glass. (4) The addition of soda and lime to lead glasses increases the hardness.

The results obtained by Lecrenier are given in Table IX, the figures in the column under calculated hardness being obtained by means of Auerbach's factors.

It will be seen that a fairly close agreement is obtained with the one exception of glass No. 12. In view of this large divergence and the close agreement of the remaining values, it would at first appear as if some experimental discrepancy had entered into the result, but reference to Auerbach's list (Table VI) shows that his glass No. 1 has the same general constitution as glass No. 12 with a co-efficient of absolute hardness of 223.

The occasional occurrence of such large differences between observed and calculated values, however, certainly requires an explanation. As shown in Tables VIII and IX, the factors assigned to the oxides by Auerbach have proved a fairly accurate basis upon which to calculate the co-efficient of absolute hardness, for out of 25 cases only three results are found that disagree at all seriously.

That the representation fails in certain cases may be due to some departure from the formula that the hardness

---

* Sprechsaal, 38, 1665, 1705.

Table IX.

Glass No.	Composition Per Cent.							Co-efficient of Absolute Hardness.	
	SiO_2	B_2O_3	Na_2O	K_2O	PbO	BaO	CaO		
1	55.2	—	—	9.92	34.81	—	—	265	272 — 3%
2	49.17	—	—	9.39	41.17	—	—	262	260 + 1
3	58.35	—	7.87	3.91	29.42	—	—	233	231 + 1
4	61.74	—	7.40	1.38	25.0	—	3.73	202	203 — 0
5	61.0	—	11.24	—	—	26.91	—	231	225 + 3
6	71.66	—	13.85	—	2.41	—	11.48	133	132 + 1
7	67.91	—	—	20.52	—	—	10.82	243	237 + 2
8	72.04	—	17.02	—	—	—	10.19	134	130 + 3
9	73.08	—	15.84	—	—	—	10.33	141	136 + 4
10	72.19	—	15.62	—	—	—	11.55	130	126 + 3
11	73.26	—	14.43	—	—	—	11.71	131	131 ± 0
12	68.42	2.51	15.83	3.4	—	—	8.03	226	150 + 34

of a glass is a linear function of the percentages of its constituent oxides. This is known to be true with at least one oxide in its effect upon certain of the properties of glass.

In boro-silicate glasses, the additive relationship suggested by Schott between boric oxide and expansion is found not to hold over a wide range, the reduction in expansion at first brought about by additional boric oxide ultimately reaching a minimum. Further additions of the oxide then bring about an increase in the expansion. Moreover, it is found that this departure from the linear formula depends to a certain extent upon the constitution of the glass. With glasses containing 10 per cent. Na_2O, the minimum expansion occurs with about 20 per cent. B_2O_3, while with twice the content of alkali, the minimum occurs at about 16-17 per cent. B_2O_3. In face of this it would almost appear that the factor for B_2O_3 is useless when the quantity of the oxide exceeds 20 per cent., but such is not the case. A close agreement is found between observed and calculated values in almost every instance where the content of B_2O_3 exceeds 20 per cent. It must be pointed out, however, that glasses of this type usually contain no SiO_2, whereas with boro-silicate glasses both B_2O_3 and SiO_2 come into competition for the basic oxides.

The occurrence of minima in the expansion curves of boro-silicate glasses is not the only example of a break in the linear relationship between chemical composition and physical properties. Maxima occur in the case of the refractive index, density, and annealing temperature.

The foregoing notes suggest that the explanation of the differences that sometimes occur between observed and calculated values of hardness may possibly lie in the direction of a departure from the linear formula due to some critical alteration in the constitution of the glass.

On the other hand there are grounds for doubting the actual value of certain of the factors assigned by Auerbach to the oxides. Lecrenier's conclusion that boric oxide imparts great hardness to glass has already been mentioned, but it will be noticed from Auerbach's list (Table VII) that the factor assigned to that oxide does not indicate any specially noteworthy effect on the property of hardness. An arrangement of Auerbach's factors in descending order of magnitude shows that boric oxide occupies the seventh place, being inferior even to K_2O and superior only to Na_2O and CaO. It is a well-known fact, however, that the boro-silicate glasses used for chemical-ware and plant, lamp chimneys, miners' lamp-glasses, cooking-ware, etc., are of a distinctly hard nature. Moreover, Lecrenier's conclusion that boric oxide imparts hardness is amply supported by the observations* of Turner and his co-workers at Sheffield, who made a study of the melting and working properties of sodium boro-silicates. The investigations extended to 34 glasses containing varying proportions of silica, sodium oxide and boric oxide. In the series containing 20 per cent. Na_2O and from 10 to 20 per cent. B_2O_3, special hardness and resistance to abrasion was noticed, while another particularly hard glass, and one which resisted the action of the file, contained silica 65 per cent., sodium oxide 5 per cent., and boric oxide 30 per cent.

Further evidence of the value of boric oxide in imparting hardness is gained from the tests at the U.S. Bureau of Standards upon the resistance of glass vessels to mechanical shock. The tests consisted in dropping vessels, such as beakers, on a board from heights increasing by five inches until the vessel broke or withstood a fall of 45 inches. Hardness is a property that considerably enhances the resistance to this form of shock. The results of the tests are given in Table X below.

Table X.

Glass No.	Boric oxide content.	Average drop tolerated.
1	— per cent.	6.6 inches
2	3.6 ,,	7.5 ,,
3	6.2 ,,	9.16 ,,
4	8.1 ,,	15.83 ,,
5	10.8 ,,	16.6 ,,
6	10.9 ,,	10.0 ,,
7	11.8 ,,	30.83 ,,

It will be noticed that, with the one exception of Glass No. 6, the drop increases consistently with the content of boric oxide. This again argues in favour of the value of boric oxide in imparting hardness so that there are considerable grounds for doubting the validity of the factor assigned by Auerbach to boric oxide.

Factors for calculating the co-efficient of hardness (or any other property) should certainly not be accepted as being generally applicable until further research has disclosed the exact relationship of the properties of glass to its chemical constitution.

◆

In virtue of a Swedish Royal Decree, dated 23rd April, and effective as from 1st May, the Customs import duty on sheet glass (coloured or not) and plate glass, not silvered or etched, in flat sheets, with a total length and breadth of less than 245 cms. (Tariff Nos. 682-3), has been increased to 10 öre per kilogramme.

---

* J. Soc. Glass Tech., 1923, VII, 56.

Vitreous Enamel Colours.
Stains for Glass.
Oxides for Colouring Glass Metal.
Selenium Metal.
Selenate and Selenite of Soda.

GROUND BONE, FELSPAR, FLINT, FLUORSPAR, QUARTZ, STONE, WHITING, ETC.,
CARBONATE & SULPHATE OF BARYTES
OXIDES OF ANTIMONY, ARSENIC, CHROME, COBALT, SMALTS, COPPER, IRON MANGANESE, NICKEL, TIN TITANIUM URANIUM, ZINC, ETC
TRADE MARK
WENGERS, LTD.
CERAMIC COLOURS & CHEMICALS
ETRURIA.
STOKE-ON-TRENT.
England.
Samples & Price Lists Sent on Demand.
COLOURS FOR POTTERS, GLAZED BRICK MANUFACTURERS, & GLASSMAKERS.
PREPARED ENAMELS FOR CAST & SHEET IRON, COPPER & JEWELLERY,

Limespar.
Phosphate of Lime.
Nitrate of Soda.
Nitrate of Potash.
Opavetro for Opacifying Glass.
Alumina, Oxide and Hydrate.

THE TESTING OF MILK BOTTLES AND THE EFFECT OF DESIGN OF THE BOTTLE HEAD UPON BREAKAGE.*

By applying engineering principles to the design of milk bottle rings, the author of the article—Mr. F. W. Kouwenhoven, Instructor in Mechanical Engineering at the John Hopkins University, Baltimore—was able to reduce the breakage very considerably.

He studied the breakage problem at the request of a Baltimore dairy early in 1923, and no published data being available, proceeded to devise tests as follows, using quart bottles only.

Vertical Compression Test.

When using a universal testing machine with bottle in vertical position the weakest bottle withstood a load of 2,400 lbs. and the strongest a compression load of 6,200 lbs., the average of 30, of different manufacture, being 4,250 lbs. As even 2,400 lbs. is far in excess of anything met with in use, this test was discontinued.

Side Compression.

The bottle was placed between two others, all laid horizontally between the heads of the testing machine. Average load to fracture centre bottle 978 lbs., though the variation was large.

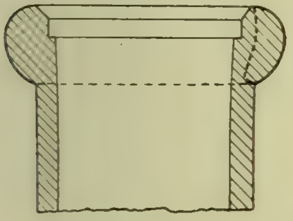


Fig. 1.

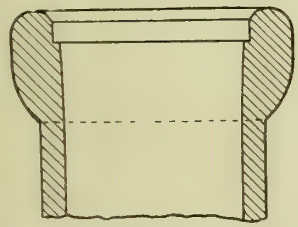


Fig. 2

Compression Test of Ring.

The rings were placed between two 1 inch steel blocks mounted on the heads of the testing machine, and the average load to fracture rings as shown in Fig. 1 was 1,125 lbs., whilst the average for rings of the improved design shown in Fig. 2 was 1,350 lbs. In each case 50 samples were tried. The author states that it was found necessary to place the specimens always in the same relative position owing to the fact that some makes were stronger when the mould joint marks were in the horizontal plane and others when they were in the vertical plane.

Internal Hydrostatic Test.

The average internal pressure required to fracture 82 bottles of various manufactures was 185 lbs. per sq. in.

Temperature Tests.

As all bottles withstood the change from cold to hot water having a temperature difference of 170° F. (94.4° C.), it was decided to concentrate on testing under the reverse conditions, i.e. hot to cold.

It was found that a well designed, well annealed quart bottle would safely withstand a temperature change of 85° F. (47.2° C.) when the upper temperature was 150° F. (65.5° C.). The upper temperature was found to affect the results to the following extent :—With an initial temperature of 130° F. (54.4° C.) the safe temperature drop was 88° F. (59.0° C.), whilst with an initial upper temperature of 210° F. (98.8° C.) a temperature drop of 80° F. (44.4° C.) was only reasonably safe. The method of testing was to stand the bottles for four minutes immersed in water at the desired upper temperature, the water temperature being kept constant and the water in circulation by means of a motor driven stirrer. The bottle was then rapidly emptied—being handled with rubber protected gas pliers—and plunged bottom downwards at an angle of approximately 30° beneath the surface of the cold water and allowed to fill.

Tapping Tests.

It was found that in the dairy itself the approximate distribution of breakage loss was 70 per cent. due to breakage of the ring and ring only, the remaining 30 per cent. covering all other breakages.

Consequently attention was directed to the type and shape of ring employed.

A "tapping" test was therefore devised and a small machine built. This was essentially a 4 oz. fitter's hammer with a ball-peen, mounted so that the effective weight was concentrated at the head. The motion of the hammer was controlled by a motor-driven cam, giving it a free fall of about 3 ins. 100 times per minute. A counter was fitted to enable a record to be taken of the number of blows required to fracture the rings. The peening end of the hammer was arranged to strike the ring at its highest point (indicated by arrows in the figures) and the test was carried on until the ring was damaged or cracked to an extent that rendered the bottle useless. Tests on bottles with rings as shown in Fig. 1 gave an average of 12 blows, the fracture generally being along the path shown in dotted lines in Fig. 1.

With the modified ring shown in Fig. 2 well over 500 blows were required to render the bottle useless, and then it was found that the hammer had pulverised the glass without fracturing the ring.

Impact Test.

A small impact testing machine was constructed to try out the new type ring in comparison with the old shape.

The machine was simply a 7.5 lb. steel ball carried at the end of a light shaft, which in turn was carried by a cross shaft mounted in ball bearings so that the ball swings through a vertical plane. It developed 275 inch pounds of energy when dropped from a holding point (approximately 30° from the horizontal). Results showed that an average of 52.4 in. lbs. of energy were required to fracture the old type rings whilst the new design required an average of 92.4 in. lbs. to fracture those that did break, as one of every four could not be broken with the full 275 in. lbs. available.

It was also found that the material of which the hammer or ball was made had an effect on the results, and the same remarks apply with reference to fixing the bottle as in the case of the compression tests on the rings.

Since the new shape was introduced to the dairy the chipped ring or neck loss—previously 70 per cent. of the total—has almost disappeared.

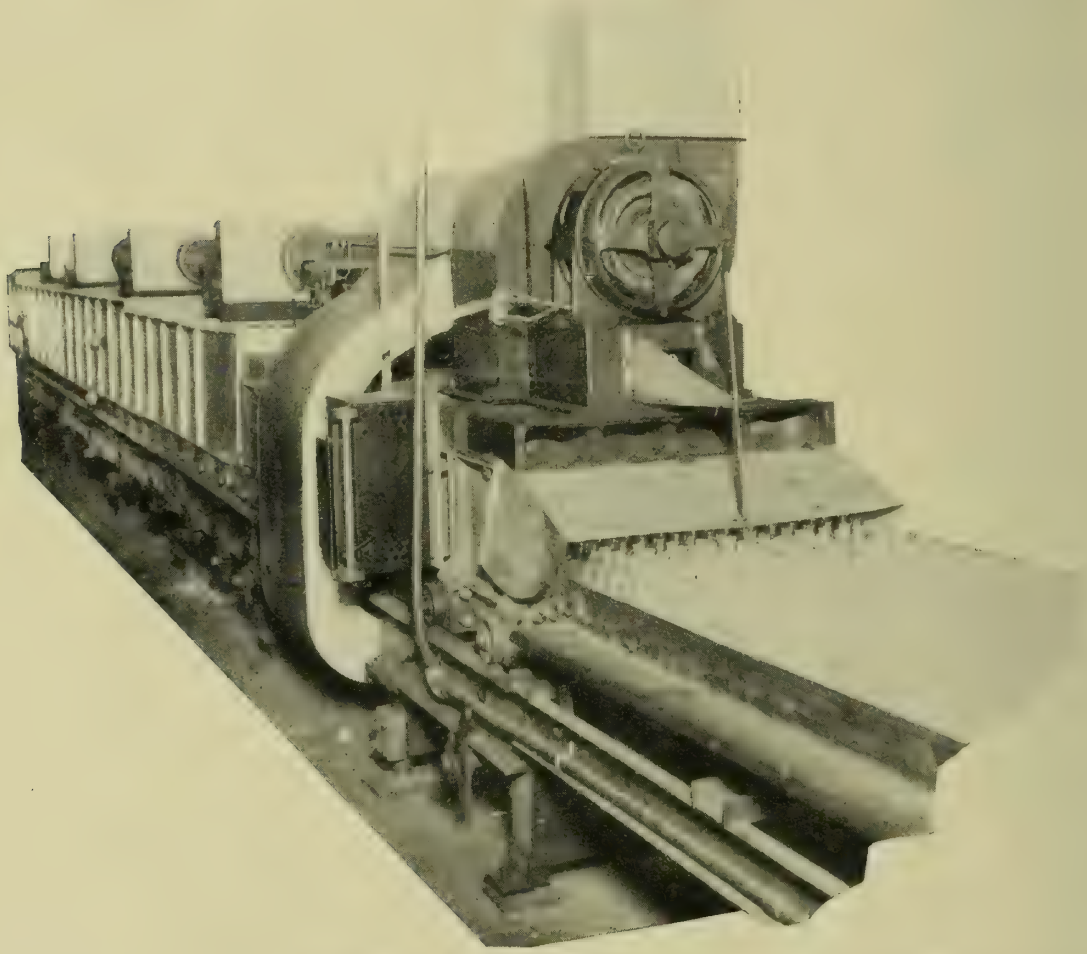
---

*Mechanical Engineering. New York. June, 1926.

THE HARTFORD LEHR

RELIEVES Glass Manufacturers of all

ANNEALING ANXIETIES



The problem of annealing Glass Ware has always been the most difficult of the Glass Manufacturer's many difficulties.

Numerous devices have been developed to minimise annealing troubles, but no real and final solution was found until the recent invention of the HARTFORD LEHR.

The outstanding features of the HARTFORD LEHR are :—

(1) THE HARTFORD LEHR IS A SCIENTIFIC INSTRUMENT.

The Lehr is remarkable for the accuracy and precision with which the temperature conditions can be controlled. Conditions to give the desired annealing temperature curves can be accurately predetermined and reproduced at will.

(2) REGULAR AND RELIABLE FUNCTIONING.

THE HARTFORD LEHR NEVER FAILS to perform its functions of annealing. Other Lehrs "happen" to anneal **some** of the ware **sometimes**. The HARTFORD LEHR is unique in that it anneals **ALL OF THE WARE ALL THE TIME.**

(3) FUEL ECONOMY AND SIMPLICITY OF HEATING CONTROL.

Only **ONE** small burner is required.

Perhaps the most attractive feature of the HARTFORD LEHR is the astoundingly small fuel consumption. This, however, results from the fact that the lehr has been specially designed with the view of utilising to the maximum extent the initial heat resident in the ware when it leaves the Forming Machines. In one of the most up-to-date Automatic Glass Manufacturing Plants in Great Britain, a careful comparison of the HARTFORD LEHR fuel consumption over a period of ten weeks with that of modern Muffle Lehrs shows a clear direct saving of at least 65 per cent. in Fuel Costs.

(4) COMPACT AND ROBUST STRUCTURE.

Occupying merely a fraction of the space of the ordinary annealing plant, the HARTFORD LEHR is almost solely a structure of metallic parts which have been designed to permit of ease and accuracy in erection and at the same time ensure a light yet sound and substantial structure. The total absence of foundations and flues is specially noteworthy.

(5) EASE AND ECONOMY IN OPERATION.

Less labour is required, and the conditions under which the work of placing ware in the lehr is carried out constitute a vast improvement upon all other types of Lehr. There is no walking backwards and forwards between the Forming Machine and Lehr. The takers-in quickly " take to " the HARTFORD LEHR. Moreover, the sorter can handle efficiently and more comfortably, an appreciably larger quantity of ware than from the older types of Lehr.

(6) RAPIDITY OF ANNEALING.

The HARTFORD LEHR is notable for the almost amazing speed with which annealing is accomplished. As is well known, usually about four, and sometimes as long as eight hours, are considered necessary for annealing bottles on the older type Lehrs. On the HARTFORD LEHR the time taken varies from 50 minutes to 150 minutes, according to the weight of ware introduced per unit time. The advantages of this feature, particularly in permitting inspection so shortly after leaving the Forming Machine, are readily apparent.

(7) NEGLIGIBLE MAINTENANCE COST.

Although several HARTFORD LEHRS have operated continuously for periods upwards of 12 months, so far **NO** up-keep repairs have been necessary.

(8) NO LOSS OF WARE.

For the first time an annealing process is available in which there is NO ware melted, " starved," " stuck," marked, cracked, or broken in Lehring. More striking still, there is no loss of ware for poor annealing when starting up after the usual weekly shut-down.

(9) FLEXIBILITY.

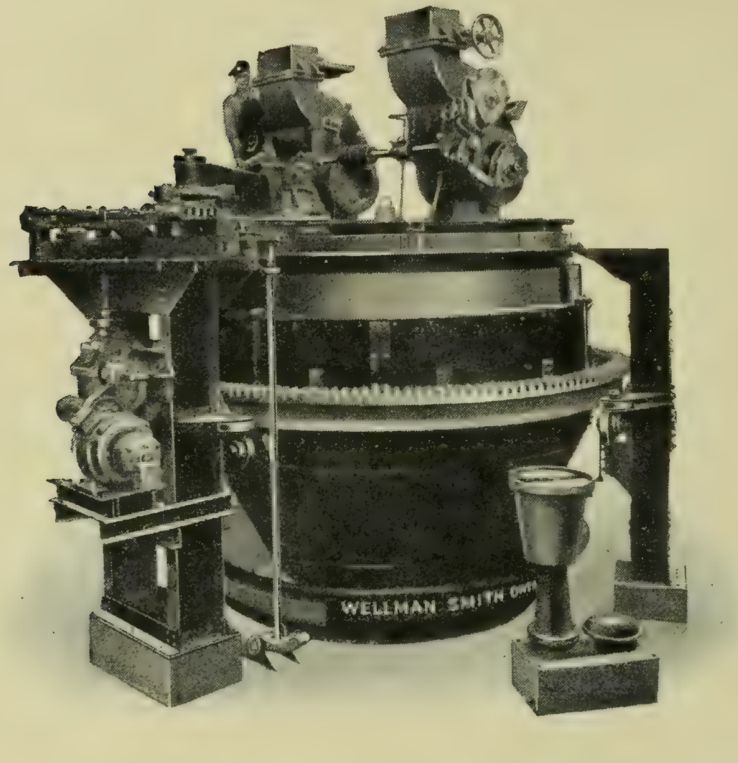
Without sacrificing the precision with which the Lehr can be controlled, the dimensions and proportions have been carefully selected in order to establish the widest operating margins. It has thus been possible to produce a standard design which meets all the needs of the average Glass Manufacturing Plant. The existence of these wide operating margins, added to the unfailing regularity of control, establishes for the first time in the mind of the Manufacturer a sense of security and confidence that the ware **is being annealed AT ALL TIMES.**

For further particulars, price and delivery apply to :—

THE BRITISH HARTFORD-FAIRMONT SYNDICATE, LTD.
142-143, AUDREY HOUSE, ELY PLACE, LONDON, E.C.1.

Glass Machinery Specialists — Glass Works Engineers
"Hartford" Automatic Feeders—Forming Machines—Lehrs.

WELLMAN GAS MACHINES



Automatic from coal feed to ash delivery.

Oscillating Poker ensures constant rich gas at all outputs.

Intermittent ash pan motion prevents clinker bridging.

Lowest labour and running cost of any producer.

Size 10 TO GASIFY UP TO 4,000-lbs. COAL PER HOUR.

Size 8 TO GASIFY UP TO 2,600-lbs. COAL PER HOUR.

Every Glassworks Manager and Engineer should send for our handbook on Gas Making.

THE WELLMAN SMITH OWEN ENG. CORP., LTD.

36-38, KINGSWAY, LONDON, W.C.2.
WORKS :: :: DARLASTON, S. STAFFS.

Telephones: HOLBORN 2588/9.
Telegrams: "PRINCIPIUM, WESTCENT, LONDON."

The Society of Glass Technology.

The two-day meeting held by the Society in London on June 1st and 2nd closed the session 1925-26. This session has been distinguished by a marked increase in the activities of the Society, and the meetings in London, including the Annual Dinner, held on the evening of June 1st, at the Hotel Cecil, provided a suitable finish to the work of the season.

The 91st Ordinary General Meeting.

The first session of the meeting was held in University College, Gower Street, the newly-elected President, Mr. Walter Butterworth, M.A., in the chair.

A warm welcome was extended to a party of members of the Stained Glass Association of America who were present. These American visitors were touring Great Britain and the Continent, and were the guests of the Society at the Annual Dinner. Members of the British Society of Master Glass Painters were also present at the meeting in University College, when eleven ordinary, and two collective new members were elected.

The very interesting lecture and demonstration given by Professor Sir W. M. Flinders Petrie, F.R.S., on "Glass in Early Ages," and the account of the Annual Dinner were reported in our last month's issue.

During the morning of June 2nd members of the Society had the privilege of visiting the Osram G.E.C. Glass Works,* and the Research Laboratories of the General Electric Co., Ltd., at Wembley. Members were entertained to luncheon and tea by the Directors of the Company, and no effort was spared to make the visit interesting and instructive. The party of visitors numbered about thirty, and, divided into small sections, a detailed inspection was made throughout the glass works and the laboratories. At the works, the whole story of the production of glass lamp bulbs was unfolded. The working of the plant, which was completely automatic, was truly fascinating.

During the tour of the laboratories the methods of testing finished lamps, so as to gain data regarding their life, efficiency, and illuminating power were shown. Many interesting pieces of research work relating both to the metal filaments and the glass were in progress, and were fully explained to the visitors. Some of this work was very fascinating, and interest never lagged. The time was all too short. The Company, and the Head of the Laboratories, are to be congratulated on the fine equipment and general organisation of the Laboratories.

After the luncheon a hearty vote of thanks to the Directors of the Company, coupled with the name of Mr. C. Wilson, was proposed by the President of the Society, Mr. W. Butterworth (Senr.). Colonel S. C. Halse very ably seconded, and the vote was heartily accorded. Mr. C. Wilson replied, giving a short, but interesting account of the growth of the Works at Wembley and Leamington, and of the Laboratories. He emphasised the fact that the company could not get on without its Research Laboratories. Mr. C. C. Paterson supported Mr. Wilson's statements.

In the afternoon a general meeting was held in the Library of the Research Laboratories, the following papers being read and discussed :—

(a) "**Opal Glass,**" by Mr. J. W. Ryde. This was a communication from the Research Laboratories of the G.E.C.

The author divided opal glasses into two groups, those which obscured a source of light, placed behind them, and those through which a red image of the source was visible, the glass itself appearing bluish.

The theories which had previously been put forward as to the cause of opalescence in glasses were reviewed, then the results of experiments made with a number of commercial and experimental opal and opalescent glasses were given. These glasses had been examined by the X-ray method in order to determine the nature of the opacifying material which separated out. From the X-ray patterns obtained it was shown that sodium fluoride, or calcium fluoride, or a mixture of both had separated out from the glasses examined, the lime and soda contents of which were quoted. It was also found that no X-ray pattern was obtained from one of the glasses, and the opacity in this case was shown to be due to the presence of bubbles. From another glass,

Maintain Efficiency
in the hot weather

In sheet glass and bottle works, etc., where intense heat handicaps the workers, a system of STURTEVANT COLD AIR DOUCHE has proved immensely valuable. It delivers a supply of cool fresh air at those points where the men are working under trying conditions, with consequent improvement in output both as regards quantity and quality.

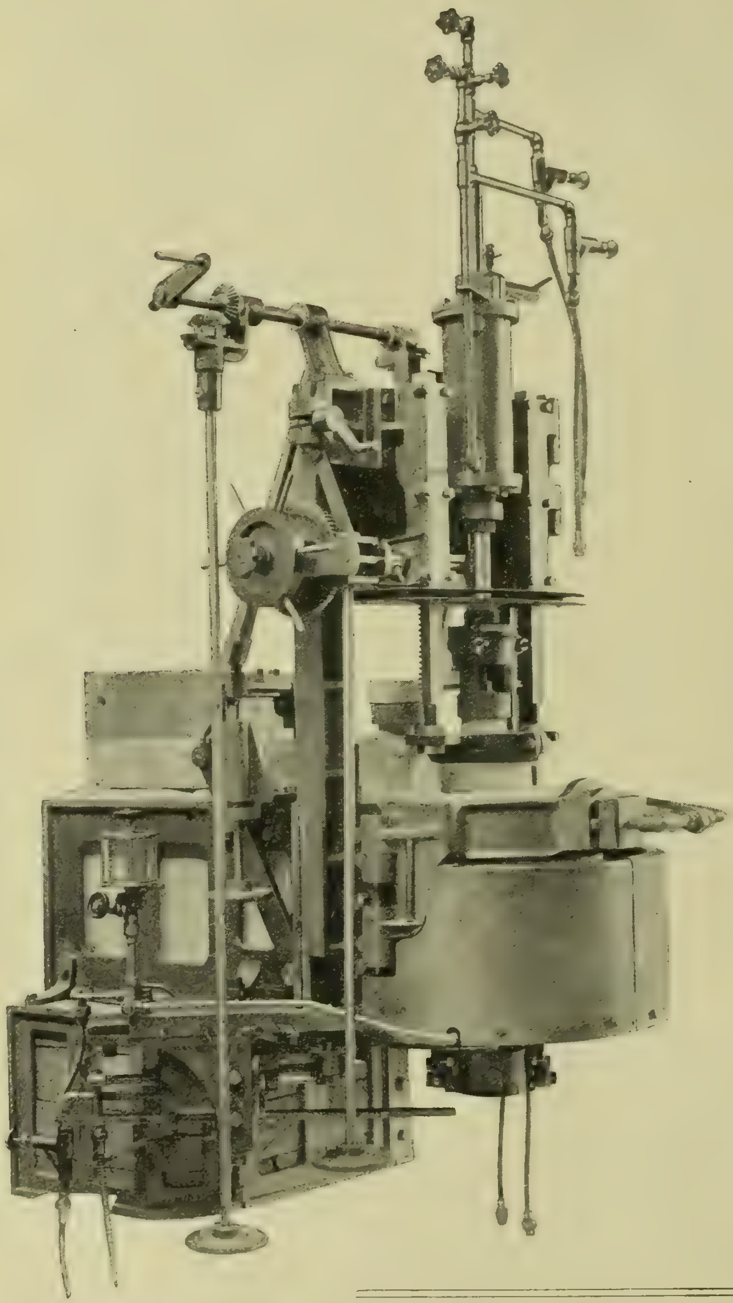
If you have any ventilating problems, large or small, write to Dept. G.L.31 for particulars and our booklet G.L.1241 which will be sent to you without further obligation.

STURTEVANT ENGINEERING Co. LTD.
149 QUEEN VICTORIA ST. LONDON E.C.4.

---

*For description of these works, see the last issue of this Journal.

The "RANKIN" Automatic Glass Feeder.



RESULTS JUSTIFY CLAIMS.

Claims without justification are futile.

The need for automatic production is admitted by every glass manufacturer. The question is—what mechanism can be installed with the assurance of the best results?

The "RANKIN" record is unrivalled in the Glass Feeder world. Its history is unique. In no instance has a "RANKIN" installation once installed been superseded. On the contrary, wherever it has been adopted, further installations have followed.

The latest proof of this claim is a repeat order for **TWELVE FEEDERS** from a Glass Manufacturing Company, who originally put in one Feeder for comparison with other similar devices. This we believe to be

THE LARGEST INDIVIDUAL ORDER EVER PLACED FOR AUTOMATIC FEEDERS

and represents a great triumph for an All-British Built Feeder.

The mechanism, material and finish are of the highest possible quality. The "RANKIN" Feeder is built for service and will outlast all others.

Demonstrations of the RANKIN AUTOMATIC GLASS FEEDER will be arranged by appointment.

For Illustrations, Descriptive details and terms apply to :

THE RANKIN AUTOMATIC GLASS FEEDER CO.,

1, CHARTERHOUSE STREET, LONDON, E.C.1.

Telegrams : Natiglaso, London.

Telephone Nos. : Holborn, 140 and 141.

containing very little lime, only sodium fluoride separated out. As the lime contents of the glasses were increased an increasing quantity of calcium fluoride separated out. The patterns obtained were shown on lantern slides. The effect of the rate of cooling on the depth of opal produced had been investigated, and it was found that with slow cooling the size of the particles separating out was increased until a certain limiting size was reached.

The optical properties of opal glasses were discussed, and the influence of the size of the opacifying particles and of the total mass of the particles on the transmission of light was demonstrated by means of certain specially prepared "opal" solutions.

A solution containing relatively large particles appeared bright by transmitted light, but dark by reflected light. With large particle size then, maximum intensity of the directly transmitted beam was obtained.

An interesting discussion followed the reading of the paper, Dr. S. English, Professor W. E. S. Turner, Dr. C. J. Peddle, and Mr. Coad-Pryor contributing.

(b) **The Electrical Conductivity of Glasses at High Temperatures.** By F. F. S. Bryson, M.A., B.Sc., F.Inst.P.

The electrical conductivity of several series of glasses was determined at temperatures between the softening points and 1150° C. The glass was heated in a small cylindrical crucible in a platinum wound electric furnace, and the resistance between two platinum electrodes immersed in the glass was measured very carefully.

The results obtained showed that a considerable increase in conductivity followed when soda was substituted for silica in a simple soda-silica glass. In three-component glasses the conductivity was increased when silica was substituted by magnesia; but it was decreased by the replacement of silica or soda by alumina. The temperature-resistance curves for several of the glasses bore a close relationship to the temperature-viscosity curves for similar glasses, and suggested the possibility of using conductivity measurements as a method of determining changes in the viscosity of a glass immediately before "working out."

The author described an arrangement which had been used in order to obtain a record of the variation in the conductivity of the glass flowing along the channel leading from the tank to a bottle-making machine.

Professor W. E. S. Turner, and Mr. B. P. Dudding raised interesting points in connection with this paper, and Mr. Bryson replied.

(c) **The Influence of Moisture on the Rate of Melting and on the Properties of Soda-Lime Glasses.** By Miss E. M. Firth, B.Sc., F. W. Hodkin, B.Sc., M. Parkin, M.Sc., and Prof. W. E. S. Turner.

This paper, presented by Professor Turner, embodied the results of experiments made with four series of meltings, in two of which soda was introduced solely as soda ash, while in the other two it was introduced partly as salt cake. Moisture was present in quantities ranging from 0.25 to 15 per cent. in different batches. In general, the presence of a limited amount of moisture had a beneficial effect on the rate of melting. In the case of batches containing no salt cake, the best results appeared to be obtained with about 1 per cent., and not exceeding 2 per cent.; for batches containing salt cake 3 to 4 per cent. of moisture could be used.

The glasses made from batches containing salt cake were refined more easily, and were freer from waviness than those prepared from batches containing soda ash only. Glasses made from batches of which the moisture content was in excess of a certain proportion, were found to be more viscous, and to have a shorter working range than those obtained from ordinary dry batches.

(d) **The Physical Properties of Zinc-Oxide Containing Glasses.** By S. English, D.Sc., and Prof. W. E. S. Turner.

Owing to lack of time this paper had to be taken as read.

After tea, a party of members took advantage of the kind invitation issued by Messrs. The Rockware Syndicate, and visited the Glass Works at Greenford. A new type of lehr,* in which the glassware itself furnished the major portion of the heat, was here seen in operation.

The Next Meeting—October 20th, 1926.

The meetings of the Society are to be suspended during the months June-October, following the usual custom. The next meeting will therefore be held on October 20th, 1926. More than this cannot be said at the moment, but full particulars of the programme arranged for this meeting will appear in the October issue of GLASS.

V.D.

---

*This lehr was fully described in our February issue.—ED.

FURTHER DEVELOPMENTS
IN
FOSTER PYROMETERS

Several new forms of Pyrometers, which will be of interest to Glassworks engineers, are described in a new catalogue, just ready.

Ask for Book No. 42S.

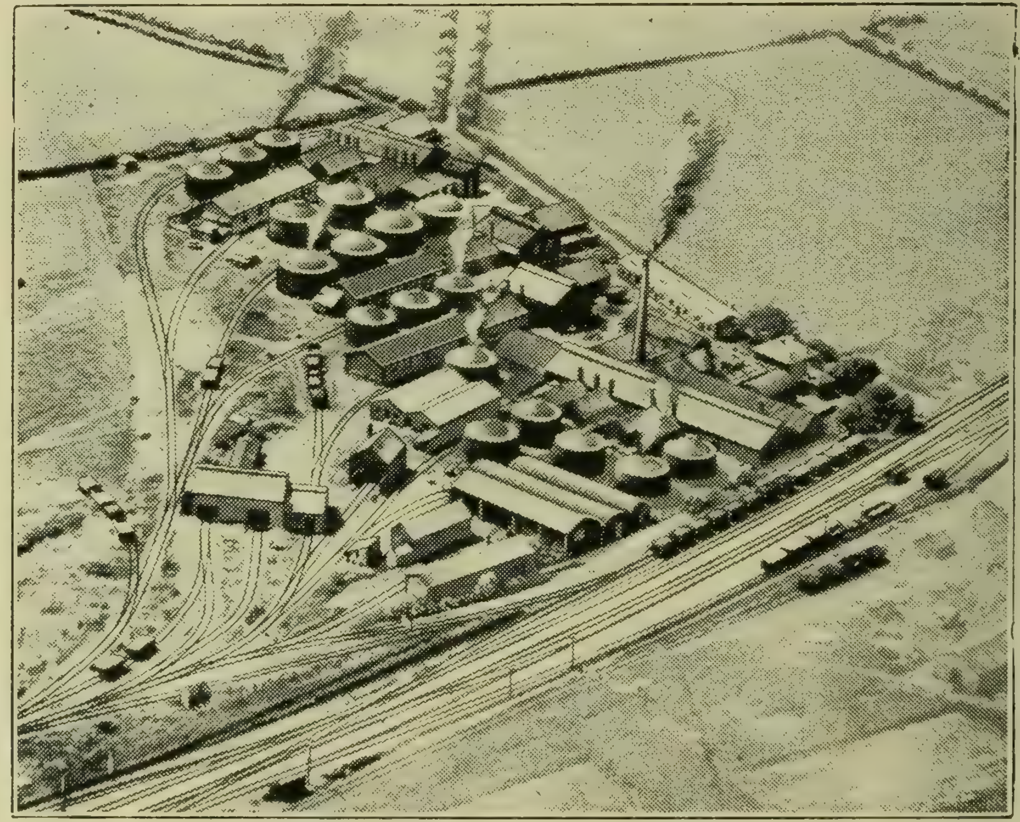
FOSTER INSTRUMENT CO.,
LETCHWORTH, HERTS.
"The Pyrometer People."

Telephone: Letchworth 26.
RESILIA
Telegrams: "Resilia, Letchworth."

THE MOST DURABLE **BRICK**
MADE FOR **GLASS FURNACES.**

STEPHENS SILICA "C"

EXTREMELY REFRACTORY, TOUGH AND DURABLE.



VIEW TAKEN FROM AN AEROPLANE.

Kiln Capacity 1½ Million Bricks. Works Cover over 9 Acres.

SUPER SILICA CEMENT for setting SILICA BRICK.

Used by most of the principal GLASS WORKS.

STEPHENS & CO., KIDWELLY.

The Use of Compressed Air—*Continued.*

By ROBERT WILSON.

Power Required to Drive Air Compressors.

The power required to drive an air compressor depends, principally, on its capacity at a specified delivery pressure, the work of compressing and delivering the air usually being the greatest portion of the total work done in driving the machine. Another portion of the total power taken is converted into mechanical energy and is dissipated in overcoming the inertia and friction of the moving parts.

The ratio of the work required to compress and deliver the air to the total work done in driving the machine, is called the *Mechanical Efficiency*, this ratio representing the percentage of the total power utilised as mechanical energy, and for the expenditure of which there is no compensating return.

A certain portion of the work done in compressing the air also is dissipated, this portion being proportionate to the amount of heat left in the air during the process of compression. Further causes for dissipation of power in the compression of air are (1) the cylinder pressure exceeding the delivery pressure, and (2) the suction pressure being less than atmospheric pressure. These pressure losses are the result of valve loading and of throttling.

The energy available in the air at point of use usually is equal to the work necessary to compress the same volume of air isothermally, for the reason that the temperature of the compressed air at point of use is about equal to that of the surrounding atmosphere. That is, the temperature of the compressed air at point of use usually is equal to the temperature which would obtain at the end of isothermal compression, and therefore, the work which must be done as the result of the heat produced during compression is entirely lost. The ratio of the work required to compress the volume of air delivered by isothermal compression, to the actual work done on the air in the compressor cylinder is called the *Compression Efficiency*, and the ratio of the isothermal work to the actual work done in driving the machine is called the *Overall Efficiency*.

Power Readings.

The actual or net work done in the cylinder of an air compressor can be ascertained, in a fairly accurate manner, by means of the indicator diagram, the area of which represents to scale the net work of the compressor cycle. The extent to which the suction and compression pressures are affected by throttling and valve loading and the proportion of the displacement volume which is delivered at each stroke are also discernible from the diagram, besides which valuable information frequently may be gained as to the influence of the cooling system on the compression and expansion processes, the state and action of the valves and the state of the piston and piston rings. All these factors influence the ratio between the work done and the capacity delivered, and in respect to this ratio it is important to remember, as was explained in the article on volumetric efficiency—issues of January, March and April—that the loss of capacity resulting from high initial temperature is not discernible from the indicator diagram. It is conceivable therefore that indicator diagrams taken from similar type machines, working to the same air pressure, might agree closely in area, consequently representing the same work done, and yet the capacities of the machines might be very much different due to the cooling in one machine being better than that in another and to the effects of valve loading, and throttling being different for each machine.

The inference to be taken from this is that the area represented by the indicator diagram is not alone sufficient with which to compare the capacity, nor can the power required to drive an air compressor be taken as a guide to its capacity. If compressed air could be utilised exactly as it is delivered from the compressor cylinder then the power readings would more closely represent the work value or energy contained in the compressed air. This, however, is never possible, and as the energy contained in compressed air depends on its temperature a comparison of power readings only as a guide to capacity is inaccurate and apt to be misleading.

The only practicable manner of referring to the work done in the compressor cylinder is in relation to the volume of free air delivered at the pressure specified. If, therefore, the work of the compressor cycle be deduced from the indicator diagram, the ratio of work done to capacity delivered can be obtained only if particulars are available from which the capacity can be measured. To secure these particulars it is necessary to have a compressor on the test bed. Most makers adopt this procedure, but, for general purposes, the computation of the indicated horse power *theoretically* required in a compressor cylinder is made comparatively simple with the aid of a table of constants which give the power required to compress and deliver one cubic foot of free air per minute to various gauge pressures, by means of single-stage compression. This table of power constants is now to be found in most text books, but if these constants are used without comprehension of the average conditions in practice, then considerable error is possible.

Table of Power Constants.

The constants in the table have been calculated on the assumption that compression begins at atmospheric pressure at sea level, and at an initial temperature of 60° F., and ceases at exactly the delivered pressure. They have been calculated for both isothermal and adiabatic compression, but as the perfect conditions on which those for the latter are based are almost impossible in practice, it is necessary to make certain allowances so that the extra work entailed, as the result of the unavoidable departures from the perfect conditions, may be provided for.

The departures from the perfect conditions have already been shown to be in the nature of excess pressure ratio due to throttling and valve loading, and to the

PARKINSON & SPENCER, Ltd.

Ambler Thorn Fireclay Works,
HALIFAX, YORKSHIRE.

ESTABLISHED
1800.

Telephone : No. 1207.
Telegrams : Parkinson & Spencer, 1207 Halifax

Manufacturers of Refractory Goods of every description for the Glass industry, viz :

GLASS-HOUSE POT CLAY, FIRE CLAY, FIREBRICKS, TANK BLOCKS, BINDERS, etc.

Our Tank Blocks are unsurpassed for quality and durability.

WE SPECIALIZE IN BEST POT CLAY MATERIAL.

New Plant recently erected for the cutting and dressing of Tank Blocks to any dimensions.

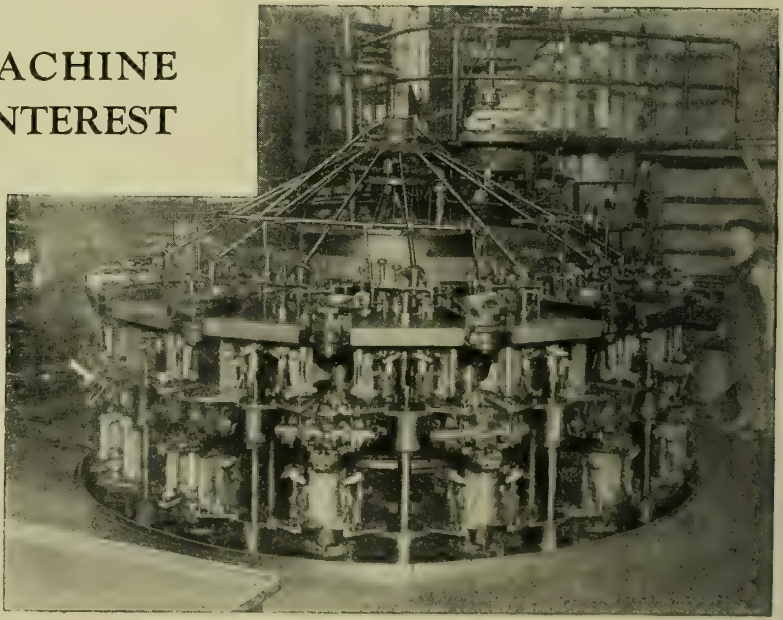
FAVOUR US WITH YOUR ORDERS AND YOU WILL BE SATISFIED WITH RESULTS.

NEW GRAHAM MACHINE CREATING GREAT INTEREST

Offers unusual advantages because of improved construction. Eliminates intermittent rotation which causes wear and tear through jerking. Continuous rotation permits larger production and lower operating costs.

Flexibility of operation appreciated. Produces both narrow and wide mouth bottles in wide range of sizes. Makes push-up bottoms without separate operation.

Three sizes of same construction.
AZ Machine, 15 blank and 15 blow molds
AY Machine, 10 blank and 10 blow molds
AY6 Machine, 6 blank and 6 blow molds
Molds and mold operating parts are interchangeable.



AZ Flow Type—Maximum Speed 72 Bottles per Minute

THE OWENS BOTTLE COMPANY—TOLEDO, OHIO, U. S. A.

Ask us for illustrated catalog, giving complete information.

initial temperature being higher than that of the surrounding atmosphere. These factors cannot be ignored in practice, affecting as they do the ratio of power required to capacity delivered, and as the allowance which must be made to cover them varies with the compression ratio, it is necessary to make a brief survey of the compressor cycle in order that these allowances can be made in the proportion required. It is necessary also to recognise that the one cubic foot of free air on which the calculations are based is the capacity *delivered* per minute and not piston displacement.

Survey of the Compressor Cycle.

A survey of the compressor cycle would include the following :—

(1) The work of compression.
(2) The work involved due to the pressure at the end of compression being higher than the delivery pressure.
(3) The work of re-expansion.
(4) The work involved due to the suction pressure being lower than atmospheric pressure.

The first two of these factors affect the positive work and the other two affect the negative work, the difference between the positive and the negative work representing the net work.

(1) The work of compression. It has been demonstrated in previous articles that any saving which it is possible to effect in the compression of air must be as the result of cooling the air during compression and prior to its discharge from the compressor cylinder. It also has been shown that, as the result of cooling by water jackets, a little cooling takes place in the latter half of the compression stroke, but that the advantage of this cooling is offset by the " heating " which occurs during the first portion of compression, when, due to the temperature of the metal being higher than that of the air drawn into the cylinder, heat flows from the metal to the air. This transfer of heat from the metal to the air continues until, with further compression, the temperature of the air exceeds that of the metal and so allows heat to flow from the air to the metal.

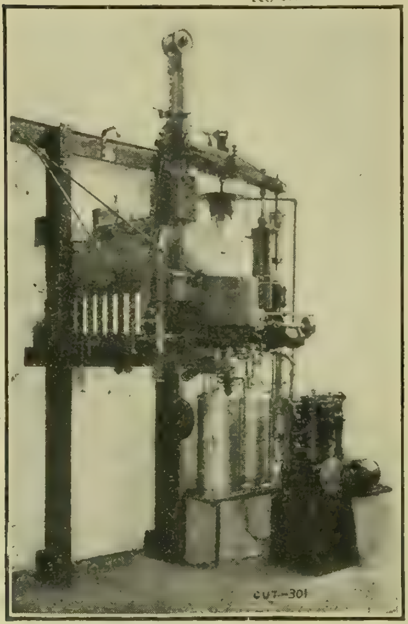
Now, adiabatic compression requires that no heat enters or leaves the air during the process, so that the only period of the stroke when compression would be adiabatic would be for the instant when the temperatures of the air and the metal were the same. Prior to that state existing heat entered the air from the metal, so that for the first portion of compression the law of compression was worse than adiabatic. In the latter portion of the stroke the air gives up a portion of its heat to the metal, and compression then is better than adiabatic.

Obviously the proportions of these conditions, referred to the length of the stroke, will depend upon the mean temperature of the metal—in relation to the final temperature of the air in the cylinder—and also, that these proportions will determine the mean value of the compression line and whether or not this will be better or worse than adiabatic. It has been shown that the mean temperature of the metal depends on the mean temperature of the cooling water, and that the greater the difference between the maximum temperature of the air in the cylinder and the average temperature of the cooling water, the greater will be the cooling effect and, consequently, the higher the rate of heat transfer from the air to the metal. It follows, therefore, since the difference in temperature between the air and the cooling water tends to increase as the pressure rises, that the possibility of improving on adiabatic compression also increases as the pressure rises. Although, however, the average law of the compression process tends to improve as the pressure rises, other factors limit the maximum pressure which efficiently can be obtained with single-stage compression, and because of this, the mean value of the index to the compression law rarely falls below the adiabatic value. For pressures up to 20 lb. per sq. in. the average of the compression process is liable to be worse than adiabatic ; for pressures of from 20 up to 60 lb. per sq. in. the adiabatic value may be realised with good cooling facilities, and above 60 lb. per sq. in. compression slightly better than adiabatic can be obtained with good cooling facilities.

(2) (4). The work involved due to excess pressure. The reasons for the loss of power resulting from the reduction in pressure caused by throttling of the air drawn into the cylinder ; from the increased pressure required to open the automatic discharge valves against the receiver pressure, and from throttling of the air during delivery, were explained in detail in the articles on air compressor valves which appeared in the issues of this Journal for September and October, 1925. Some loss from these causes is unavoidable but it was explained that the loss can be minimised by providing ample valve area and paying due regard to the essential points of design, so that the increase of pressure resulting from the difference in area of the loaded surfaces of the valves may be kept as low as possible at the same time as the throttling losses are minimised. Consistent with reliability the valves always are made as light as possible, as are also the springs, but the weight of these also accounts for some of the extra pressure, and as there is a limit to the lightness of the valve and springs and to the minimum width which can be allowed for the valve seating, it is obvious that the increase of pressure due to these factors, over that actually required, will be a greater percentage of the total pressure for low than for high pressures, and that the actual increase, given equality of throttling losses, will measure about the same for both. Throttling losses are liable to be greater for high than for low pressures, but not sufficiently higher to offset the greater proportionate loss at low pressures as the result to valve loading. An increase of pressure amounting to 5 lb. per sq. in. is not unusual for most commercial pressures, and to this must be added a pressure reduction on the suction side amounting to say 4 ozs. per sq. in., which is a usual amount and which is not liable to vary for different pressures. Thus, the excess pressure is likely to be about 5.25 lb. per sq. in. for most commercial pressures, and, obviously, this would have a greater effect on the net work of the cycle if the final pressure was 20 lb. per sq. in. than if the final pressure was 80 lb. per sq. in.

(3) The work of re-expansion. The re-expansion of the air left in the clearance space is part of the negative work of the cycle. In re-expanding this air helps to

[*Continued on page* 333.



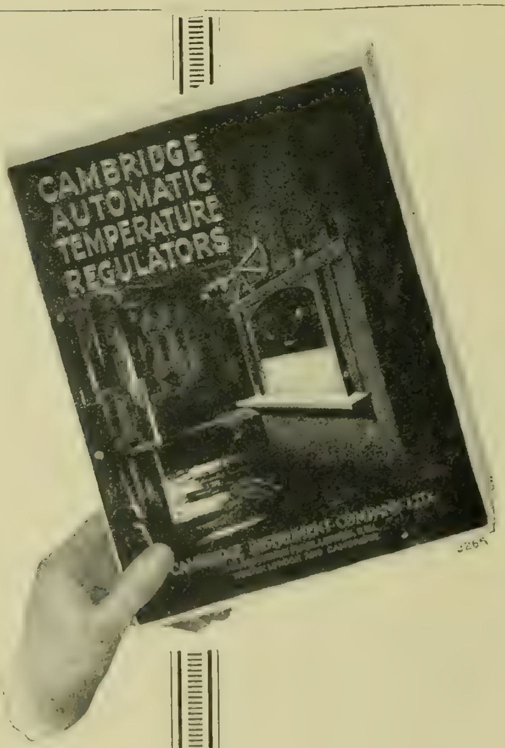
MODEL KFO.

Latest Miller Feeder

PROGRESSIVELY DEVELOPED SINCE 1907.

By arrangement with **The Morgan Crucible Co., Ltd., Battersea,** a stock of all refractory parts for our feeders is now kept in London.

WILLIAM J. MILLER, Inc., SWISSVALE, PA., U.S.A.
London Office : **366, Strand, London, W.C.2.**
Tel. No. : Regent 5647.
Cables : Autoglasma, Rand, London.
Autoglasma, Pittsburg, Pa.



THIS NEW BOOK

NO. 150-V

contains useful information regarding the automatic regulation of temperature, and describes apparatus which can be used to control the temperature of practically any type of annealing furnace. We shall be pleased to forward a copy free at your request.

CAMBRIDGE
INSTRUMENT Cº LTD

WORKS :-
LONDON &
CAMBRIDGE

Head Office & Showrooms :- 45, GROSVENOR PLACE
LONDON, S.W.1.

17

A New Glass Stone: $Na_2O \cdot 3CaO \cdot 6SiO_2$[*].

By ALBERT B. PECK.

ABSTRACT.

Attention is called to a stone of different composition than any heretofore recorded, and but recently possible of identification by petrographic-microscopic means through the work by Bowen and Morey on the system Na_2SiO_3-$CaSiO_3$-SiO_2. Various ways by which attempts were made to determine the composition of the crystals are described and a summary of the optical properties of these crystals from three sources is given. Probable places for the formation of these stones in the tank are also indicated.

Several years ago the writer received a glass stone for petrographic identification, the optical properties of which proved to coincide with those of no compound previously described in Bowen's[†] very complete description of such phenomena. Hoping that Dr. Bowen might have some later information on the subject, the stone was sent to him and the first negative result was confirmed.

In an attempt to gain some indication of its composition, the finely-ground mixture of crystals and glass was treated with various acids. Sulphuric acid had no effect upon either the crystals or glass. Nitric acid decomposed both the crystals and glass, leaving a skeleton presumably of SiO_2 in place of the crystals. Hydrochloric acid decomposed the crystals, again leaving a skeleton of SiO_2, and hydrofluoric acid dissolved both the crystals and glass. Since ordinary analysis would give the total composition of the crystals and glass combined, which would be the same as that of the undevitrified glass, the solution obtained by leaching the crystals with hydrochloric acid was analysed and the ratios of the principal oxides present were determined as follows:—$CaO : Na_2O = 2 : 1$ and $SiO_2 : CaO + Na_2O = 1.8$[‡]. Although microscopic examination showed very conclusively that the crystals were not completely dissolved, the composition of the solution further confirmed the fact that they represented an entirely new type of glass stone. But since no data were available on the ternary compounds of Na_2O, CaO, and SiO_2, the exact identity of these crystals still remained clouded, and owing to the lack of definite chemical information concerning the crystals in question, publication of all data concerning them was withheld.

A few years later Bowen[§] was led to suspect that these crystals might be the same as those of the natural mineral rivaite, the composition of which had been given as $(Na_2, Ca)Si_2O_5$. Examination of the original rivaite proved that it was in reality only wollastonite embedded in a glass, a condition quite common for glass stone. This disproved rivaite as a distinct species. Further examination of some synthetic "rivaite" showed that it in turn consisted of a glass in which were embedded some crystals similar in optical properties to those of the hitherto unidentifiable glass stone, but the presence of considerable glass in the synthetic "rivaite," still left the true composition of the crystals in doubt.

Soon after this, Insley[**] sent the writer a stone which apparently contained the same unknown crystals but in addition they appeared to be mixed with two other materials, perhaps some partly decomposed sodium carbonate and calcium carbonate. The stone effervesced with hydrochloric acid, and decomposed and became chalky upon short exposure to the air. The writer's stone is still perfectly fresh after years of exposure to the air. Insley reported his stone to have been found in the dead corners of a tank. Soon thereafter, in a description of various stones in glass, Insley[*] recorded the optical properties of these crystals, which were essentially the same as those for the original crystals noted by the writer. Insley described them simply as a sodium calcium silicate.

At a still later date the writer again attempted to obtain the composition of these crystals by leaching the powdered mixture of crystals embedded in glass with hydrochloric acid and later dissolving the remaining siliceous skeleton of the crystals with sodium hydroxide. This method gave the proportions of the constituents as $2Na_2O \cdot 3CaO \cdot 9SiO_2$, but it was clearly evident that all of the skeleton of silica had not been dissolved by the alkali.

Recently Morey and Bowen have published their findings for the system Na_2SiO_3 - $CaSiO_3$ - SiO_2.[†] In this system they found a compound $Na_2O \cdot 3CaO \cdot 6SiO_2$, which corresponded closely to the crystals found in the original glass stone. They have called attention to this in their paper. The crystals are long and slender, and have a positive optical elongation. Those noted by the writer were always diamond shaped in cross-section, which with the parallel extinction would indicate orthorhombic crystallisation, to which they have been assigned by Morey and Bowen. Insley, and Morey and Bowen, also mention hexagonal and octagonal cross-sections. The optical properties from the different sources follow:

	Peck	Insley	Morey and Bowen
α	1.565	1.562	1.564
β	1.570		1.570
γ	1.580	1.577	1.579
Optical sign	positive	positive	positive
Elongation	γ	γ	γ
Optic angle (2V)	large about 65°		75°
Crystallisation	orthorhombic?		orthorhombic

The stones in the possession of the writer occur as nodules up to two inches or slightly greater in diameter, surrounded by clear glass. They have very much the appearance of wollastonite stones and are true devitrification products. The stones were first found in the sheets as they were drawn from the tank.

Morey and Bowen point out that the crystals form-

[Continued on page 333.

---

[*] Presented at the Annual Meeting, AMERICAN CERAMIC SOCIETY, Atlanta, Ga., Feb., 1926. (Glass Division.)

[†] *Jour. Amer. Ceram. Soc.*, 1, 594-605 (1918).

[‡] Private communication.

[§] *Amer. Mineralogist*, 7, 64-66 (1922).

[**] Private Communication.

[*] *Jour. Amer. Ceram. Soc.*, 7, 14-18 (1924).

[†] *Jour. Soc. Glass Tech.*, 9, 226-65 (1925).

TELEGRAMS:
"GLASMACHIN, ESTRAND, LONDON.
CABLES:
"GLASMACHIN, LONDON"
CODE:
BENTLEY'S.
TELEPHONE:
CENTRAL 5985.

C. SAXTON, A.M.I.E.E., M. IRON AND STEEL INST., Etc.

CONSULTING ENGINEER

Talbot House,
Arundel Street,
Strand, London, W.C.2.

BOTTLE MOULDS

ORDER YOUR MOULDS FROM

E. LUNN & Co., MOUNT STREET, GLASGOW.

Largest MAKERS of MOULDS in the UNITED KINGDOM

Quick Deliveries and Complete Satisfaction Guaranteed.

MOULDS FOR ALL TYPES OF MACHINES SUPPLIED

ALL MOULDS MADE OF CHILLED CASTINGS ONLY.

Telephone— WESTERN 2792.

Telegrams— GLASMOLD, GLASGOW.

ONE OF OUR RECENT TESTIMONIALS—

"We have one set of Ordinary Round Quart Moulds which you supplied to us which have been working for 2½ years. These are still in perfect condition, showing no cracks or any other flaw in the metal. They have been working almost continuously for the above period, only being off the machines for a week or two at a time. We have also other moulds in Square, Oval and special shapes which have been working quite as long as the Ordinary Round Quarts, although not so continuously, and these also are in perfect condition. We have always found your moulds more satisfactory than any others, and the metal you use is much more durable than any supplied by other firms."

Reference on our Testimonial File: A.B. 91.

Trade "TWENTY MULE TEAM" Mark

Granulated

BORAX

Specially refined for

ENAMELLERS AND POTTERS

BRITISH MANUFACTURE.
Guaranteed 99·50% pure.

Entirely free
from phosphates.

BORAX CONSOLIDATED LTD,
16, Eastcheap, LONDON, E.C.3.

TRADE NOTES.

The continuation of the coal strike has had a very serious effect on the glass industry, which is all the more unfortunate as there were signs of improving trade. A number of factories have been able to carry on production, generally on a reduced scale, by means of imported coal, but the general complaint is that not only is the quality available much inferior to that usually used, thus causing trouble and difficulty in maintaining temperatures, but the price is excessive. We have been informed of numerous instances in which the price per ton was more than double that previously paid.

A number of works have changed over to oil fuel and are managing to continue, and it is safe to assume that of these a good percentage will remain on oil even after the coal difficulty is settled.

Unfortunately a large number of plants have been compelled to close down production. In some instances general repairs are being effected, but there is the danger that some works will be so badly hit that they will not start up again.

* * *

For the year ending March 31st, 1926, the net profits of James Powell & Sons (Whitefriars), Ltd., amounted to £5,841, as compared with a loss of £642 for the previous year. After paying interest on debentures and bank overdraft, amounting to £6,791, there is a debit balance of £950.

* * *

Negotiations are taking place with the object of starting the sheet glass works of the Prague Glashütten A.G. The estimated annual production is about $6\frac{1}{2}$ million square feet.

* * *

No information is available yet as to the new investigation into production costs of sheet and plate glass which was ordered by the U.S. Tariff Commission some months ago. Window glass from Europe arrives in New York at the rate of 20,000 boxes a month and plate at the rate of 1,200-1,500 cases.

The U.S. manufacturers are agitating for increased Custom duties to protect the American industry.

* * *

The new plate glass plant of the Ford Motor Co. at St. Paul, Minnesota, is now operating, with an output of 12,000 square feet polished plate per day.

* * *

If the Canadian Government will grant further tariff protection to counteract the influence of the depreciated French and Belgian currency, the Libbey-Owens Sheet Glass Co., Ltd., of Hamilton, Ont., will reopen, and probably the productive equipment be doubled.

* * *

The great advantage in plate production of the continuous process as developed by the Ford Co. is shown by figures recently published by Henry Ford, who states that his River Rouge Plant produces 12 million sq. ft. annually, or twice as much as the Glassmere plant (using the pot method), which occupies twice the space and employs three times as many men.

* * *

The Directors of the Rockware Glass Syndicate, Ltd., are so satisfied with the results obtained from the first Hartford lehr which has been operating in their plant for more than ten weeks, that they have placed an order for eight more Hartfords to replace existing lehrs.

* * *

The second Hartford lehr in this country is now being erected in the St. Helen's Works of Messrs. Pilkington Bros., Ltd.

* * *

The next British Industries Fair, the thirteenth of the series, will be held at the White City, Shepherd's Bush, London, and at Castle Bromwich, Birmingham, from the 21st February to the 4th March, 1927.

* * *

As a preliminary step towards standardisation of methods of analysis of glass and glass making materials, the American Ceramic Society have had prepared a standard sample of glass.

This is being sent to chemists connected with glass works, who are expected to send details of the results they obtain and the methods used, all of which will be treated as confidential.

The average results will then be sent to all so that each can check his own results.

WARNING TO THE GLASS TRADE.

Attention is called to British Patent No. 202,610, granted to Wm. J. Miller, entitled "Process and Apparatus for Feeding Glass," and NOTICE IS HEREBY GIVEN that LEGAL PROCEEDINGS will be instituted immediately against any makers or users of glass feeders wherein the glass is fed to a mould or the like from a receptacle in which the glass is given a movement transverse to the flow from the receptacle, as by rotary motion, whereby the consistency of the glass is rendered homogeneous.

On July 1st it was stated that the plate glass situation in Belgium was very satisfactory. Demand is good and prices are upheld.

For the third quarter of the year the production of polished plate has been fixed at 87.5 per cent. of the maximum capacity.

As regards sheet glass, owing to the uncertainty of the exchange rates, the situation is very quiet, particularly in respect to hand blown sheet. Conditions are somewhat better with the machine drawn factories and prices are upheld, especially in the better qualities.

With reference to the bottle industry, the fine weather has improved the demand slightly. As an indication of prices the following may be of interest. In lots of 10,000, green glass, in bulk, with allowance of 4 per cent. for breakage during transport :—1 litre, 83 francs per 100 ; $\frac{3}{4}$ litre, 73 francs ; $\frac{1}{2}$ litre, 68 francs ; $\frac{1}{3}$ litre, 63 francs ; $\frac{1}{4}$ litre, 58 francs. In lots of 5,000 prices are increased by 2.5 francs per 100, lots of 1,000 increased 5 francs per 100. In white flint prices are increased 4 francs per 100.

New DEVELOPMENTS in
GLASS FURNACES:

TEISEN New Wasp-Shape continuous Tank Recuperative Type

with longitudinal travel of flame. The most up-to-date Machine Tank, possessing Stream line features and securing:

- High Efficiency
- Long Life
- Constancy of Temperature
- Easy Means of Regulation
- Good Access to Repair to the Throat

TEISEN New T Shape Cross Flame Tank Regenerative Type

For the largest capacities securing:

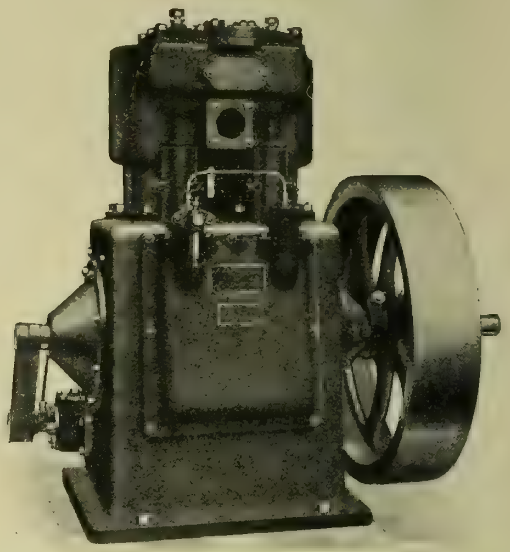
High Output with Economy of Fuel by better utilisation of the flame. Designed on the principle of the Modern Open Hearth Furnace.

LET ME STUDY YOUR PROBLEMS.
Individual Attention to all Furnace Matters.

Write Now—

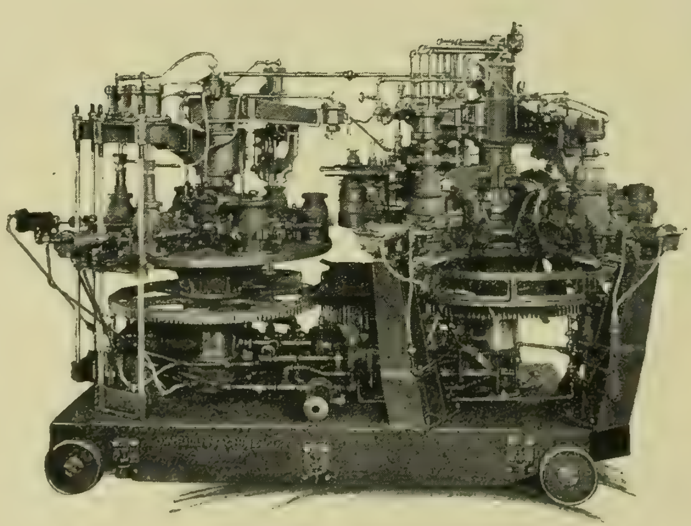
Th. TEISEN, C. E.
Furnace Engineer,
20a, Temple Street,
BIRMINGHAM.
Phone—Central 1806. *Cables*—TETE, BIRMINGHAM

"BROOMWADE"



AIR COMPRESSORS
BRITISH AND BEST
FOR ALL DUTIES.

BROOM & WADE, Ltd., HIGH WYCOMBE



The New O'Neill No. 44 Blowing Machine.

A well-built, high speed blowing machine with a range from 6 oz. to 40 oz. in capacity. Operating speeds up to 23 per minute depending on the class of ware being made. Have our London representative give you the details.

THE O'NEILL MACHINE CO.,
TOLEDO, OHIO, U.S.A.

LONDON OFFICE: 10 SAVOY ST., STRAND, LONDON, W.C.2.

A New Glass Stone.—

(*Continued from page* 329).

ing these stones, as well as those of most other compounds of Na_2O - CaO - SiO_2, are rather unstable and exist without dissociation only through a small range of temperature. Hence, they will be formed only under very specialised conditions. Furthermore, the compound $Na_2O \cdot 3CaO \cdot 6SiO_2$ has a decomposition point of only 1047°C., the lowest decomposition or melting point of any of the compounds in the system, although it may exist in pure Na_2O - CaO - SiO_2 mixtures as low as 725°C. The presence of Insley's crystals in the dead corners of a tank is suggestive in this connection.

The stone described in this paper was probably due to some other cooling influences. As these accumulations were freed either mechanically or naturally, stones would appear in the sheets. A higher temperature in the drawing chamber, perhaps only very slightly greater on account of the low dissociation point of this compound ($Na_2O \cdot 3CaO \cdot 6SiO_2$), would probably eliminate the difficulty.

Thus another " trouble maker " has been added to the list of glass stones which may be identified by petrographic-microscopic methods, and with its identification assured, correctives for its elimination when it occurs can be applied. This study shows how elusive is the identity of some of these compounds until exact physical-chemical and petrographic-microscopic methods are brought to bear upon them.

Use of Compressed Air—

(*Continued from page* 327.)

move the piston on the return stroke, the amount of the work done being proportionate to the distance travelled by the piston while expansion continues ; but its relative value cannot be measured in this way. The conditions which prolong re-expansion are (a) large clearance space and (b) high compression ratio, but, as has already been shown, either of these conditions gives a low value for volumetric efficiency. Thus, the conditions which give the higher value for the work of re-expansion give the lower value for the volumetric efficiency, which means that when the work of expansion is greatest the capacity of the compressor is least, so that the effect of the work of re-expansion, on the nett work of the compressor cycle is practically balanced by the effect of re-expansion on the capacity of the machine. Therefore, in calculating the work required to compress and deliver a given volume of free air, it is unnecessary to take into account the effect of re-expansion. In other words it can be assumed that the work expended in compressing the clearance air is returned during re-expansion. This assumption, however, is not quite correct, for if it were possible to so proportion the clearance space that none of the air compressed could be delivered from the cylinder, but was simply re-expanded on the return stroke, again to fill the cylinder so that no fresh air could be drawn in, it could not be expected that no positive work would be done in the cylinder. In average practical conditions, however, the difference between the work expended in compressing the clearance air and the work given back during re-expansion is rarely sufficient to affect the net work of the compressor cycle and, therefore, generally can be ignored.

(*To be continued.*)

SILLIMANITE

The High Temperature Resisting

Refractory Material.

(*Softening Point above 1800°C.*).

Supplied ground from – 10 mesh to – 100 mesh.
For all bricks, blocks, flue linings, siege coverings, and glasshouse pots and rings.

For the convenience of users who desire to have sillimanite ready prepared with binder, the following mixtures are also supplied dry or ready for use:—

Slip, Pot and Ring Mixtures.
(Prof. W. E. S. Turner's Formulæ).

Tank Block, Brick & Pot Mixtures.
(Mr. W. J. Rees' Formulæ).

Siege Mixture.
(Glass Research Association's Formula).
For lining the floor siege of pot furnaces and general purposes, patching, etc.

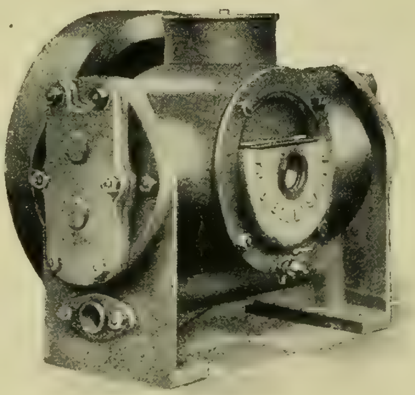
The P.B. SILLIMANITE
COMPANY, LIMITED,
Sole Agents: PAWLE AND BRELICK.
791, SALISBURY HOUSE,
LONDON WALL, LONDON, E.C.2.
Telephone Number - London Wall 4825.
Telegrams - - PLATOONS, LONDON.

AIR COMPRESSORS & VACUUM PUMPS

As Illustrated
in 5 sizes
from
10 to 80
cubic feet per
minute

Other types
Larger sizes

Any Pressure
or Vacuum



LACY-HULBERT & CO., LTD.

BOREAS WORKS, BEDDINGTON
NR. CROYDON, SURREY
Telephone: CROYDON 1698.

Moulds

Machined to specification from finest crucible chilled castings by highly skilled craftsmen; our works equipment ensures accuracy and superiority of finish.

SPECIALITIES—

Mould equipment for **Lynch, Miller, O'Neill** and other Automatic Machines.
Glassworks Patterns, Crucible Iron Castings.

ALL ORDERS EXECUTED PROMPTLY.

Johnson Radley & Sons, Ltd.,
Chesney Works, Hunslet, LEEDS.

Telegrams—MOULDS, LEEDS. Telephone—LEEDS 21354.

TECHNICAL BOOKS.

The following are of special interest:—

A TEXTBOOK OF GLASS TECHNOLOGY.
Hodkin & Cousen. 551 pp. 251 Illustrations.
42/- net.

MODERN GAS PRODUCERS.
N. E. Rambush. 545 pp. 356 Illustrations.
55/- net.

THE FLOW OF GASES IN FURNACES.
Groume-Grjimailo. 397 pp., including Appendix on Furnace Design.
27/6 net.

OIL FUEL.
Its Supply, Composition and Application.
E. Butler. 4th Edition. 310 pp. 158 Illustrations.
12/6 net.

INDUSTRIAL FURNACES.
W. E. Trinks. Vol. 1. 2nd Edition.
22/6 net.
Vol. II. 405 pp. 292 Illustrations.
27/6 net.

THE DECIMAL PLATE AND SHEET GLASS CALCULATOR.
Samuel S. Lindsay,
Comptroller of the Pittsburgh Plate Glass Company.
29/6 net.

One large glass company estimate they are saving £600 a year in one department by the use of this book.

ANY Technical Book can be obtained from—

GLASS PUBLICATIONS, LTD.,
Talbot House Arundel Street,
Strand, LONDON, W.C.2.
Telephone: Central 5985.

Glass-Making in Ancient Egypt.

By JAMES H. GARDINER, F.Inst.P., F.C.S.

In a recent article on the subject of coloured glass-making* attention was drawn to the ancient glass vase shown in the accompanying illustration.

This specimen of early glass work can be seen in the Egyptian gallery of the British Museum.

It was found at Tell-el-Amarna in Upper Egypt, and there is little doubt that it is the work of an Egyptian craftsman of about the year 1350 B.C. or even earlier.

The methods employed by the glass blower in those early days have been the subject of much speculation. The vase in question is hollow and the mouth is open and round, the ornamentation is produced by coloured glasses formed into patterns on the surface.

In Sir Flinders Petrie's book, *Tell-el-Amarna,* the following possible method for the production of glass vessels at that period is suggested.

" A tapering rod of metal was taken, as thick as the interior of the neck. On the end of this was formed a core of fine sand as large as the interior of the vase. The rod and core were then dipped into the melted glass and coated . . . when the whole was finished the metal rod on cooling would contract and loose from the glass."

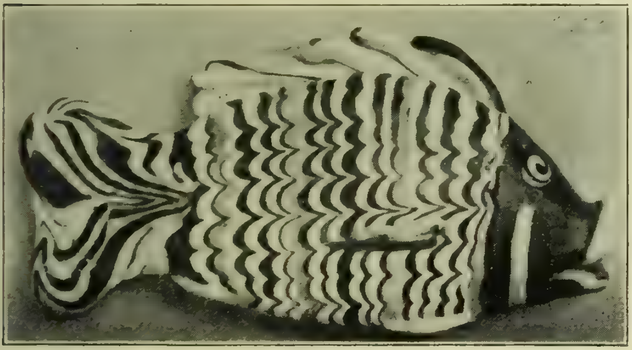


Fig. 1.

As the matter is one of considerable interest to those engaged in modern glass production, the writer has taken the opportunity of studying the subject from the technical point of view.

The technical difficulties involved in coating a refractory core with molten glass and afterwards removing it are so great that many glass makers would hesitate to agree that bottles, vases, and other objects could have been produced in this manner.

The late Mr. Harry Powell, in his article on glass making in the *Encyclopedia Britannica* suggests the following alternative.

" The primitive glass maker—having blown the body of the vase, finished the mouth and neck part and fixed a small, probably hollow, copper rod inside the finished neck by pressing the neck upon the rod. Having severed the body of the vase from the blowing iron, he heated and closed the fractured base whilst holding the vase by means of the rod fixed in the neck."

From this it is clear that Mr. Harry Powell looked upon these articles as having been blown from a blowing iron, but the writer and many practical glass makers would halt at the idea of handling the partly finished object by pushing a copper rod into the mouth or neck and afterwards removing it while it was still soft enough to allow of this being done without breaking it.

Having closely examined many of the vessels and fragments of glass made during this period, the writer realises the great difference between them and the thin blown dishes and vessels produced in the Greek and Roman times of a thousand years later, but at the same time he feels convinced that the true method of production must differ from anything that has yet been suggested.

Through the courtesy of Sir Flinders Petrie and Dr. Hall, of the Department of Egyptian and Assyrian Antiquities, British Museum, the writer has been able to make a minute examination of the articles in question.

The period of manufacture is that of the XVIIIth Egyptian dynasty which extended from 1587 B.C. to 1327 B.C. It was the time when the power and culture of Egypt reached its greatest height, and most of the objects under consideration appear to have been produced at that strange " City of the Horizon of Aton," founded by Amanhotep IV or Akhnaton, and in which was developed some of the finest examples of Egyptian art and paintings that modern search and excavation has revealed.

The city in question was built on a stretch of sand on the banks of the Nile some miles below the modern Luxor, in the locality now known as Tell-el-Amarna. It was here that Pharaoh Tutankhamen (of whom so much has been heard lately) ascended the throne, and upon whose return to the ancient capital at Thebes (Luxor) the romantic " City of the Horizon " was allowed to fall into ruin.

The excavations upon this site carried out by Professor Petrie and others has brought to light many objects of extreme interest, and it has become clear that the manufacture of glass, particularly coloured glass, and frets was extensively practiced there.

The positions of several glasshouses have been located, and in addition to vases and other objects found, there has been unearthed a mass of material in the form of broken glass-pots and saggars with partly melted batch which throw a strong light upon the methods of production employed.

Sir Flinders Petrie is of the opinion that the furnaces that were used were small and that they were fired with straw, as large quantities of straw ash was found with them.

The melting or fretting appears to have been carried out in shallow pans or saggars supported upon blocks or clay cylinders. Broken pans containing partly founded batch have been found, from which it would appear that silica in the form of finely crushed quartz was used rather than sand, and there are other evidences that the need for purity of material was fully recognised, even to the extent of thickly lining the clay melting pots with specially purified refractory material.

---

* GLASS Feb. 1926. Page 94.

There are reasons why Sir Flinders Petrie and other Egyptologists are not prepared to accept the suggestion that the glass vessels made at this time were produced by blowing, and as these reasons are certainly very weighty ones it will be well to refer to some of them before proceeding further.

So far as is known no article of copper or other metal in the form of a tube that could have been used as a blowing iron has been found.

No single glass article or fragment has been found in which the interior is clean and smooth as would result from their having been gathered from molten glass and blown into shape.

All the hollow vessels that have been found appear to have been filled with some refractory substance that has firmly adhered to the glass and in some cases; where this material has broken away it has left an impression of the rough surface upon the glass with which it has been in contact.

All the articles are thick and heavy, and nothing has been found in any way similar to the thin blown flasks, bottles and other well known objects of the Roman or early Christian times.

By the kindness of Sir Flinders Petrie, who has presented me with several specimens of coloured glass rods from Tell-el-Amarna I have been able to estimate the melting properties of the glass, the softening or plastic temperature is probably about 900° C, not a great deal below that of ordinary good English flint glass and rather higher than that of some fancy coloured rod and tube produced a few years ago in a French factory. Most of the Egyptian rod has been made from a material full of seed and is therefore full of fine bores. Possibly this was intentional as it gives a lively appearance to the rod; some, however, has been drawn from material more approaching the "plain" stage and which would have needed quite 1000° C. to form.

The colour and appearance of this latter material is almost exactly the same as that of the body of the fish vase illustrated in this article, and the following notes are from a detailed examination.

The vase has been broken into fragments and cemented together again, which is fortunate, as some of the pieces are missing and this enables one to see that the body is made of transparent blue glass and is about a tenth of an inch in thickness.

The shape is oval in section and the surface is covered with coloured glass stripes which have been drawn into loops pointing towards the head.

The tail-piece is made of translucent white glass and is ornamental with coloured stripes formed in the same way, but the flutings do not correspond to those on the body.

The end of the tail is plain white and the streaks of colour at the sides do not meet each other.

The mouth is open and circular, and the lips, which continue quite to the edge of the opening, are coated with the same yellow glass that is used for ornamenting the body of the fish.

The eye is of white glass and the pupil is formed by a dab of black glass with the streak curled round so as to give a realistic appearance. This is shown in Fig. 2 at (*a*) and is an instance of a very delicate touch of the part of the craftsman.

The round open mouth shows signs of abrasion as if a metal rod or tube had been forced into it and removed while the metal was still soft; the inside of the body is rough.

The extreme end of the tail appears to have been rounded and smoothed by grinding.

The fins are placed on the top and sides and have been attached after the formation of the coloured pattern which continues on either side of them.

From a consideration of the preceding notes it is possible to arrive at some tolerably safe conclusions as to how the article was made.

The glass of which the body is made, is a well melted blue soda metal with fine seeds; from experiments with a similar glass from the same source one would conclude that it had been maintained for some time at a temperature approximating to 1000° to 1100° C.

As far as can be seen from the specimen, the tail portion is solid, and by the fact that the ornamentation does not correspond to that of the body it is clear that it has been made and ornamented first and then squeezed on to the soft body. Although this does not appear in the photograph, by holding the article in the hands it is possible to feel the indentation of the flat nosed tongs that have been used for this purpose.

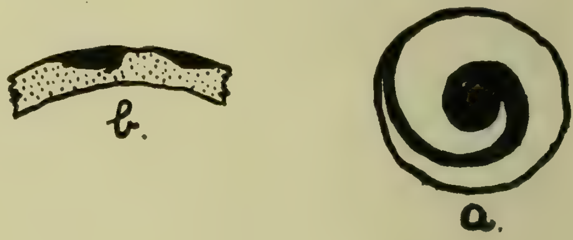


Fig. 2.

The coloured glass that forms the pattern has not been laid on as a vitreous paint, but by threading coloured glasses on to the surface and marvering them in so as to make the surface smooth. This method of ornamentation is common to nearly all the glass vessels of the period, and by an examination of the numerous fragments of glass in Professor Petrie's collection it can be seen that the coloured glasses have been laid on in round threads for in section they have the appearance given at *b*, Fig. 2. It can also be seen that the white glass was harder than the yellow, the white threads having sharp edges, while the yellow has diffused into the glass of the body.

The lips, shown white in the photograph, are covered with the soft yellow glass that was used in the stripes on the body and as they completely cover the edge of the glass it is evident that they must have been formed last and that the support for holding it was not at the head but at the tail.

Although not apparent in the print, examination shows that the coloured lines do not continue right over the end and that there is plenty of room for the attachment of a pontil.

On the whole, and in spite of the very weighty negative evidence of any indications of blowing tools or of fragments showing clean inside surfaces, the writer is strongly of the opinion that in the glass objects of the XVIIIth Eygptian dynasty we have indications of the beginnings of fabrication of glass vessels by blowing that afterwards developed into the true blown ware of the Greek and Roman period.

One evidence which supports the blowing theory is the fact which the writer does not think has been noticed hitherto, that the majority of the glass vessels of this period approximate to the shapes that would result from manipulating with soft viscuous lumps, the drop-like curvature of the necks of many of the vases seem to indicate this shaping rather than what would result from coating with glass, cores of refractory material shaped by hand.

There is one striking feature, which was referred to in the article in the *Encyclopedia Britannica*, namely, that in all cases there was a circular opening in the neck bearing marks of abrasion as if a metal rod or tube had been introduced and removed again while the glass was still soft. With a good deal of diffidence I would suggest that the final operation in fashioning the hollow article was to introduce while still soft a metal funnel through which hot sand or other refractory material could be quickly poured in and the funnel removed (this would account for the roughened circular opening), and the vessel was then buried in hot ashes and allowed to cool slowly.

When cold this filling could be mostly removed by picking with a bit of wire, or in some instances it may have been of such composition that it would solidify in the interior and be allowed to remain there, making the otherwise fragile glass vessel into a solid strong object.

Possibly further discoveries will throw more light on this interesting point.

One striking fact stands out by the examination of this ancient glass, and it is the very high degree of skill attained by the early craftsman. With all the knowledge and experience gained in the thousands of years that have passed since the day when that fish was made, the writer very much doubts if in any glasshouse in England to-day there could be found a workman who could " go one better."

If only our friend, Mr. H. C. Wells, could make us a " time machine " on which we could travel back to those far away days, and enable us to stand beside that dark skinned delicate-fingered workman and watch him as he fashioned that little vase that now stands in the show case at the British Museum, a silent witness of his industry and skill. Little did he dream that his work was going to be preserved for more than three thousand years to be an object of admiration to people of a nation then unborn, while he, his furnace, and even the city in which he lived, had passed into a heap of rubbish in the sand at Tell-el-Amarna.

OPTICAL SOCIETY.

At a meeting of the Optical Society, held at the Imperial College of Science and Technology, South Kensington, on Thursday, 10th June, 1926, the following papers were presented and discussed —

" The Distribution of Light in Elementary Optical Images," by L. C. Martin, A.R.C.S., D.I.C., D.Sc.

The paper presents the results of a series of calculations on the distribution of light near the " star focus " of a centered lens system in the following cases :—(a) Freedom from aberration ; (b) primary spherical aberration ; (c) zonal spherical aberration. In the two latter cases the condition chosen is that when the least residual phase difference amounts to $\pi/2$. The characteristic extra-focal effects are determined, and the effect of primary spherical aberration is discussed. In the case of zonal aberration the greatest axial intensity is not found at the focus giving least phase residuals. In both cases of aberration a concentration closely resembling in some respects the " Airy " disc characteristic of zero aberration is found. These results are an extension of those previously obtained by Conrady and Buxton.

" The Stationery Value of Axially Symmetric Functions," by T. Smith, M.A., F.Inst.P.

The formula for the stationery value of a function is put into a form which shortens the calculations involved in applying it to functions which possess special kinds of symmetry, such as that corresponding to symmetry about an axis.

" Note on the Criterion for the Best Position of Focus," by T. Smith, M.A., F.Inst.P.

The position in which the amount of energy within the first dark ring of the diffraction image of a point is a maximum is suggested as not unlikely to correspond with the best focus found by visual observation in the presence of moderate amounts of aberration.

Mr. R. A. Pilkington, Chairman of Messrs. Pilkington Brothers, glass manufacturers, of St. Helens, Lancashire, giving evidence before the Railway Rates Tribunal in London on July 5th, said that, owing to the adverse conditions under which English glass manufacturers were working, it was impossible to compete with Belgian and Czecho-Slovak manufacturers, who were not only winning the neutral Continental markets, but were monopolising the greater part of the home markets.

Pilkington Bros. employed 12,000 people in St. Helens, and the tonnage of window glass despatched was 87,000 tons per year, 14,000 tons being for export. Thirty-seven thousand tons of plate glass were also despatched, 16,000 tons being for export. Mr. Pilkington stated that Belgian wages at the present time were slightly less than a third of what was paid in England. As regards raw materials, limestone here cost 330 as against 100 in Belgium, and was about 10 per cent. higher and chemicals about 30 per cent. higher. His firm had almost discontinued the production of glass on Saturday afternoons, but the Belgians continued all the time.

The cost of Belgian glass for house glazing was about 39s. per 200 sq. ft., but his firm could not make it to sell at that price.

He sold glass to the London, Midland and Scottish Railway at 38 per cent. over pre-war price, yet he was charged 50 per cent. more for carriage than pre-war rates.

It was now proposed to increase those charges still further, and it would be a great hardship on an already overburdened industry.

BOOKS RECEIVED.

Reports of the Progress of Applied Chemistry. Vol. X, 1925. (Published by the Society of Chemical Industry, 46/47, Finsbury Square, London, E.C.2. 12s. 6d. net.)

Owing to the extent to which specialisation has been carried in recent years it has become almost impossible for a worker in one industry to keep in touch with the work done in other, and often allied, industries.

These "Annual Reports," however, do provide one way in which this very desirable object can be attained, and in connection with the volume just issued, which covers the year 1925, it is only necessary to say that it adds to the value of the whole series.

The work is divided into twenty-three main sections, but members of the glass industry will be chiefly interested in those dealing with "Glass," or Refractories, although those on "Fuel" and "Gas" both contain information of value to those interested in furnace design and operation.

The Glass section has been compiled by A. Cousen, M.Sc., A.R.C.Sc., and occupies 14 pages. It is stated that the year was somewhat uneventful with the exception of the continued activity in connection with the viscosity of glass and the clarification of ideas on the nature of the "glassy" state, due to the work of the Society of Glass Technology. Although nothing of a "startling" nature may have been achieved, the report shows that a considerable amount of valuable research work was done, the results of which are briefly given.

On the manufacturing side several innovations as regards furnace design are noted, such as the "torpedo" type introduced by T. C. Moorshead, and the Fergusson cyclone design. Several new machines have been introduced, including at least two of British development.

Turning to the Refractories section, which occupies 14 pages, and has been prepared by W. J. Rees, B.Sc., Tech., F.I.C., we find that during the year there was a steady progress in the technology of refractories.

Sillimanite receives special reference, due no doubt, to the very encouraging results that have been obtained from the use of this material in various positions in glass furnaces. In such places as the ports of tank furnaces, feeders, etc., etc., refractories made from natural Indian sillimanite are proving much more desirable than fireclay, whilst they show a marked resistance to chemical attack by molten glass. Silica refractories are dealt with, and it is interesting to see that the report mentions that there are numerous makes of British bricks which are at least equal in all respects to the highest grade American bricks. Reference is also made to several types of special refractories introduced during the year.

The utility of the volume is further increased by the provision of a satisfactory index, which is sub-divided into two sections, names and subjects.

Practical Glass Manipulation. By D. B. Briggs, M.A., A.I.C., F.C.S. (Crosby Lockwood & Son, London, E.C.4. 2s. 6d. net.)

It is safe to say that all laboratories, from the ones connected with small works, in which only routine test work is done, to the elaborately equipped installations for research work, are dependent upon glass apparatus of some form or other. Unfortunately, however, the art of glass blowing and manipulation has not received the attention that its importance justifies and consequently the appearance of this little book should do much to assist those who, whilst desirous of being able to make simple apparatus for themselves, have had no means of acquiring the requisite knowledge.

The book takes the form of instructions for performing about forty experiments. The experiments are so arranged that the reader or pupil is taken progressively from the first stage of cutting a piece of tubing, to the construction of various apparstus, such as for the electrolysis of water, requiring the sealing-in of platinum, etc., and the construction of a filter pump.

In the earlier stages all the experiments are described in great detail so that, when mentioned later on, they can be referred to for exact information, practically all the experiments being illustrated to show the various phases of manipulation.

The book is of handy pocket size and is one which should be in the possession of *every* laboratory.

The "Practical Engineer Electrical Pocket Book and Diary," 1926. (Published by Mr. Humphrey Milford, Oxford University Press, Falcon Square, London, E.C.1. 2s. 6d. net, cloth; 3s. net. pluviusine).

The mere fact that this annual pocket book has now reached its twenty-seventh year of issue, is eloquent testimony to its utility.

Its 800 pages contain information upon every branch of electrical engineering, in a form which is not only readily accessible but also understandable. A "Buyers Guide" in French, Spanish, and Russian, as well as technical dictionaries in these three languages are also incorporated.

Chemical Engineering and Chemical Catalogue. Second Edition. (Leonard Hill, 173, Fleet Street, London, E.C.4. 15s. annual subscription.)

The task before the compilers and publishers of a volume of this character is one which would deter the majority, but the first edition which was published last year was so well received that the present edition is certain of a hearty welcome. Although one notices the absence of numerous well known names amongst the various manufacturers and suppliers, yet the information given is such as to make the book of value to those whose duties involve the specification and purchase of plant, equipment, and material covered by the Catalogue, and in view of the progress which the present edition shows over the last, it is safe to assume that when the next edition is published the majority of the omissions will be rectified.

ALL technical books, including those mentioned on this page, can be obtained from Glass Publications, Ltd.

A NEW GLASS.

A patent has just been granted in America[*] for a glass which is transparent to the ultra-violet rays and which in relatively thin pieces is equal to fused quartz in this respect. Several interesting features are claimed for it, such as a low co-efficient of thermal expansion, i.e. .0000035, and the property of being a non-conductor, electrically, up to a temperature at which the glass itself melts. The glass is said to be exceptionally clear and transparent and it can be melted in pots or tanks whilst the cost is stated to be only slightly higher than that of ordinary window glass.

According to an article by the inventor[†] the following raw batches will produce this glass.

	A.	B.	C.	D.	E.	F.	G.	H.
Silica ...	30	37	40	34½	35	25	43	50
Hydrated Alumina	20	25	18	16	15	35	25	30
Boric Acid...	40	25	17	14	28	15	20	—
Fluorspar ...	10	10	8½	7	7	25	12	20
Magnesium Carbonate	—	3	—	—	—	—	—	—
Lead Oxide	—	—	16½	28½	15	—	—	—

The glasses resulting from the batches just given are shown in the following table.

	A.	B.	C.	D.	E.	F.	G.	H.	K.
SiO_2 ...	42	50	50	42	44	34	55	57	68
Al_2O_3 ...	20	20.5	13	13	12.6	32.5	22.5	23	15.5
B_2O_2 ...	30	19	12	9	19.4	13.5	14	—	10 3
CaO ...	8	8	6	5	5	20	8.5	20	5.7
MgO ...	—	2.5	—	—	—	—	—	—	.25
Na_2O ...	—	—	—	—	—	—	—	—	.25
PbO ...	—	—	19	31	19	—	—	—	—

(The glass K is an additional glass of a similar nature.)

All of the above glasses have a low silica content, not exceeding 70 per cent. and this content may be reduced as low as 25 per cent. to obtain some of the properties of this type of glass.

It will be noted that all the batches as well as the glasses contain large amounts of alumina. In the examples given, the finished glasses contain from 12.6% to 32.5% of alumina. However, it has been found that some of the properties of these glasses may be secured by providing an alumina content of 10% to 35% in the finished glass. Alumina has not heretofore been used in low-expansion glasses in large amounts, because when combined with an alkali it will produce large expansion or make the glass so hard that it is impracticable to work. In this type of glasses the alumina appears to act as a flux and increases the workability. It stops the danger of crystallization, increases stability, and tends to give low expansion.

It is evident that the compositions given are radical changes from the usual glasses. Heretofore the use of flourspar in any appreciable amounts was for the purpose of obtaining opaque or opal glasses, and it was known that by the use of such material in large amounts the pots or refractories used were attacked to a marked degree. It was found, however, that the use of fluorspar together with large amounts of alumina resulted in glasses that were exceptionally clear and transparent, and that the fluorspar did not attack the pot as much as the ordinary type of alkali glasses.

Experiments have proved that the best results are obtained when using calcium fluoride as the principal fluxing material. However, other fluorides or other compounds of the alkaline earth metals may be employed, particularly if it is not desirable to obtain transparent glass.

In some of the batches the boric oxide has been partially replaced by lead for the increasing of the fusibility and workability of the batch, while at the same time the tendency to devitrification has decreased. Lead also tends to improve the insulating properties of these glasses. Instead of lead, barium may be used in some cases.

A further advantage of this type of glass is high stability against the attack of steam, water, acids and atmospheric conditions and a fair stability against the action of alkalies. This latter property is unusual, as glasses heretofore made with substantially no alkali content are readily attacked by alkaline solutions, especially under the action of heat.

This type of glass may be melted or worked in an ordinary pot or tank. It is plastic enough through a considerable range of temperature to allow it to be pressed or blown into shape in the ordinary manner.

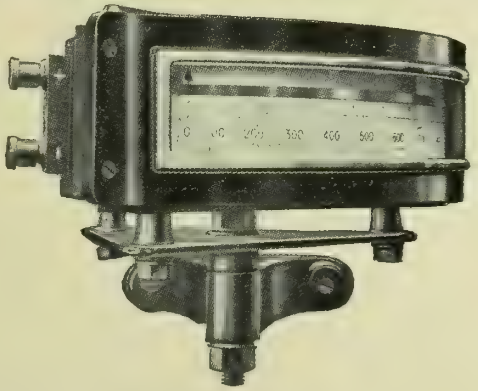
---

[*] U.S. Patent No. 1,529,259.

[†] Glass Industry, N.Y.

SIEMENS

Temperature Indicators



The instrument illustrated is only one of the numerous types of temperature indicator which we manufacture. It has a 10-inch scale with bold figuring, so that readings can easily be taken, and is fitted in a strongly constructed metal case with a swivelling wall bracket.

It is designed for use under the severe conditions experienced in works' practice.

If desired, this instrument can be supplied suitable for flush mounting on a switchboard.

Descriptive Pamphlets on application.

SIEMENS BROTHERS & CO., LTD., WOOLWICH, S.E.18.

ESTABLISHED 1858.

CATALOGUES.

Colour Standards. From Tintometer Ltd., The Colour Laboratories, 1, The Friary, Salisbury, we have received a 32 page booklet dealing with the Lovibond Tintometer for the accurate measurement of depths of colours so that they can be placed in their correct position in a permanent colour scale and registered for reproduction at any future time. This is the instrument referred to by Mr. J. H. Gardiner in his article in the March issue of this Journal (page 137) on "Coloured Glass and Glass Decoration."

Electro-Mechanical Hammers. A leaflet from the Kango Co., Ltd., 78, Petty Travel, London, S.W.1, gives details of a self contained electro-mechanical hammer, suitable for chipping, caulking, drilling, etc. The device is worked from any electric light circuit (the power required being 300 watts), and by changing the tools the hammer can be put to innumerable uses.

Lehrs.—The British Hartford Fairmont Syndicate, Ltd., Audrey House, Ely Place, London, E.C.1, have issued a leaflet enumerating some of the features of the new Hartford Lehr. The lehr has already been described in this Journal (February, 1926), and it is interesting to note that the makers' claim that the lehr ensures uniformly consistent "Grade A" annealing is confirmed by users in this country.

Tool Steels.—An excellent reference book on the choice of the correct steel to use for any particular service has been issued by Messrs. Edgar Allen & Co., Ltd., Sheffield. Known as the *Edgar Allen Steel Book* it is one which should be in the possession of all who are responsible for the purchase and heat treatment of special steels.

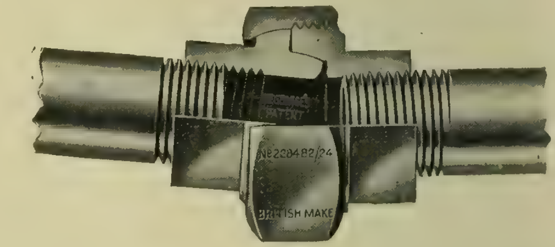
Bottle Machines.—The range of glass feeding and forming equipment made by Wm. J. Miller, Inc., of Swissvale, Pa., is well known. Leaflet No. A 99, just received, illustrates some of his machines for making wide mouth and also narrow and semi-wide mouth ware. Both electrically and pneumatically operated machines are illustrated as well as samples of bottles produced on the different machines.

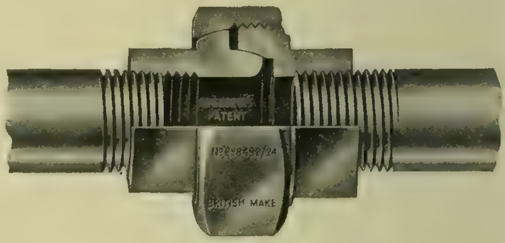
Electrical Thermometers and Pyrometers.—List No. T6 received from Messrs. Negretti & Zambra, Ltd., 38, Holborn Viaduct, London, E.C.1, gives technical descriptions and information with regard to the temperature measuring equipment they supply. The list is fully illustrated and prices are given.

A NEW TYPE OF "UNION."

The device shown in the illustrations below is one which should prove a great boon to those responsible for the erection and maintenance of the numerous pipe lines for gas, oil, air and steam, etc., to be found in every glass works.

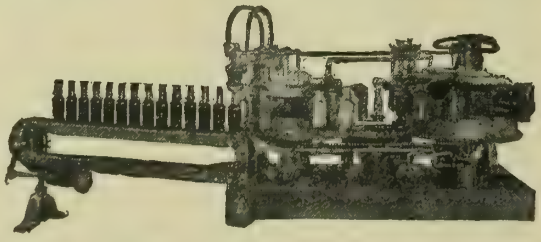
By employing two spherical seats both struck from a common centre, the inventor has made it possible to connect two pipes, although they may be as much as 10 degrees out of alignment, in any direction, without it being necessary to "spring" them into line or "set" one of them, thus avoiding the consequent constant strain on the joints or expense of setting as the case may be.





Anyone who has tried to connect, with the ordinary type of union, two pipes on a forming machine whilst it is hot, will welcome the new fittings, as in many cases such pipes have been "sprung" into line whilst cold and easy to handle, resulting in loss of time and often burnt fingers later on.

The new union is known as the "Mac" and is marketed by the Adaptable Union Co., 155, Fenchurch Street, E.C.3. It can be obtained in all sizes in both brass and gun-metal and malleable iron, whilst the self-aligning feature is also available on elbows, tees, bends, etc., in fact, in the whole range of the usual pipe fittings either in brass or malleable iron.



AUTOMATIC

May be Worked on Floor Level—No Pit Needed

NARROW NECK AND WIDE MOUTH
BOTTLE BLOWING MACHINE
No Transfer Boy. No Take-Out Boy.
STRICTLY AUTOMATIC
When Operated with Mechanical Feeding Device.
Can be Worked by Hand Gatherers. Speed 10 to 32 Bottles per minute, ranging in size from ¼ oz. to Gallon
LYNCH GLASS MACHINERY COMPANY,
ANDERSON, INDIANA, U.S.A.
Cable Address—"LYNCHNOBOY" ANDERSON
Codes—A.B.C. 5th EDITION, BENTLEY'S, WESTERN UNION

The Trade in Parliament.

(By OUR CITY CORRESPONDENT.)

The question of the Key Industry Duties was debated at some length in the Committee Stage of the Finance Bill on Tuesday, June 8th. The day before a strong letter was issued to M.P.'s on behalf of the Optical Instruments Importers, who take exception to the procedure adopted in the matter of the Committee of Enquiry. The letter reads as follows :—

" Sir,

Finance Bill—Clause 10.

" The importers of optical glass and optical instruments desire to draw your kind special attention to the proposals contained in the above Clause of the Finance Bill, which deals with the continuance for a period of ten years of the Key Industries Duties, and proposes certain increases. Optical lenses (for spectacles) and various optical requisites for educational purposes are to bear these increases, as well as cameras, binoculars, etc.

" The Key Industries Duties were originally imposed for a period of five years. A definite period of this kind was said to be necessary in order to give security to the British manufacturers in making their plans. The members of the distributive trade felt entitled to make their plans also on this same basis of a definite period, and it is regarded as distinctly unfair that there should be a sudden serious alteration by way of increase of the duties.

" Quite apart, however, from this particular element of unfairness, which operates very harshly on a large number of British firms, members of the trade generally feel they are entitled to protest very strongly against the procedure which led to this Budget announcement. You are aware that four days before the introduction of the Budget there was published a White Paper, containing the report of a Board of Trade Committee, which claims to have examined carefully the whole question of the Key Industries Duties. The fact, however, that this Committee had been appointed had so far as we are aware *never been publicly announced.*

" It now transpires that manufacturers who are beneficiaries under the duties were approached and were invited to submit evidence, but no similar invitations or communications were addressed by the Committee to trade organisations and chambers of commerce whose members have had wide experience of those duties and are vitally interested in the matter. The result is a Report which must be regarded *as based on ex parte evidence.*

" You are reminded that, when the Key Industries Duties had been running for some months, an application was put forward for additional duties to be imposed on certain goods, including optical elements and optical and scientific instruments imported from Germany. The matter was referred to a Safeguarding of Industries Committee, which sat in public and heard evidence from all responsible parties concerned. The applicants were legally represented by Sir Arthur Colefax and the opponents by Sir Thomas Inskip. *After hearing the evidence the Committee unanimously decided in favour of the opponents.* The traders claim that it is grossly unfair in these circumstances that *by contrast* an enquiry should now have been held behind closed doors, at which they had *no opportunity whatever of submitting evidence and figures* ; and that a Report issued in such circumstances should within a few hours be made the basis for action which will affect the trade for a period of ten years to come!

" Several of the statements that are made in the Report can only have been made as a result of incomplete information or misunderstanding, and it is respectfully claimed that the matter should be further examined.

" It is quite appreciated that in the vital matter of national Key Industry Duties there may be points which would require to be considered *in camera*, but this should not preclude the giving of proper opportunity to the trade to lay evidence.

" If the present Finance Bill is not amended, a 50 per cent. duty on component parts will be added to the already increased Key Industries Duties, and this proposal in itself raises many complicated questions which require investigation.

" In the circumstances you are urgently asked to support an amendment having for its object the suspension of the new duties (as distinct from the existing 33⅓ per cent. duties) *until* such time as a full and independent enquiry can have been held, and until Parliament can be satisfied that any decisions arrived at are the result of *a fair consideration of all the relevant facts from the national point of view.*"

It is hardly to be expected that the Government should modify its programme to meet any eleventh hour protest and, of course, it is very seldom that any Members of the Government Party will vote against the Whips on such an important measure as the annual Finance Bill. The result was that after certain lively passages in debate the clause was adopted without amendment.

I am told also that the Chancellor of the Exchequer has refused any concession in the matter of goods that were in transit at the time of the Budget Speech. The renewed and the increased duties will consequently be levied as from May 1st.

Merchandise Marks (Imported Goods) Bill.

The Merchandise Marks Bill was launched on its Committee career on June 12th, and up to the time of writing five sittings have been held. Progress has been very slow. The Committee took two days to consider Clause 1, which appears in the Bill as a paragraph of eight lines ; by the time the Committee had finished dealing with it the clause was enlarged to 37 lines. The effect of it is that no foreign goods will in future be allowed to be sold in this country bearing the name or mark of any firm that trades in this country ; neither a merchant nor a departmental store, nor a shopkeeper will be allowed to brand any foreign goods with his own name or initials or similar marks.

This appeared likely to raise serious difficulty in the matter of glass containers. It is well known that many British manufacturers, especially in the Perfumery industry, use imported bottles and jars for filling with their own manufactures. Amendments were put on the Order Paper to draw attention to this difficulty and to prevent the anomaly of British perfumery having to be sold by its British maker in a glass bottle bearing the name of the foreign country, simply because the name of the British perfumery manufacturer happens to be embossed or otherwise branded on the bottle. The President of the Board of Trade was evidently impressed by the criticism and on the second day himself tabled an amendment which was eventually adopted and which read as follows :—

" Articles used or to be used for any of the following purposes, that is to say, as coverings, labels, reels, or otherwise as articles in or with which goods manufactured or produced in the United Kingdom are to be sold or exposed for sale shall be excluded from the operation of this section, notwithstanding that the name or trade mark of the manufacturer, dealer, or trader in the United Kingdom is applied thereto, if the name or mark was applied with his consent."

The Committee then proceeded to deal with clause 2, which lays the foundation of the main part of the Bill. This proposes the establishment of two small paid committees. One will deal with foodstuffs, the other with general manufactured goods. In an earlier issue of GLASS some account was given of the general provisions which this part of the Bill contains. I pointed out that there was a special stipulation which would prevent the proposed tribunal from issuing any order which would prescribe compulsory marking of glassware *prior to importation.* The goods would be allowed to come into the wholesale warehouse unmarked, but in the event of any subsequent sale or offer for sale in the United Kingdom they would have to be marked with an indication of origin. On the other hand they might be re-exported without a mark. This arrangement was designed to protect the entrepot trade. It provided, however, very strong hostility from Sheffield and the Potteries, with the result that one of the Sheffield Members on the Standing Committee moved an amendment to dispense with this stipulation and to give the proposed tribunal power at discretion to require imported manufactured goods to be marked before passing the Customs. This amendment was accepted by the President of the Board of Trade, with the result that the Bill has had to be recast in certain important particulars, and the opposition of the Merchants has been considerably intensified. They complain that we are now deliberately proposing to advertise to our foreign customers the origin of the goods we sell to them with the obvious risk that having discovered our sources of supply they will go direct and dispense with our services. As the entrepot trade of the country is worth nearly £200,000,000 it is not surprising that the shipowners through the Chamber of Shipping have joined the merchants in protesting against what they regard as a commerce destroying experiment.

So far as glassware is concerned visible entrepot trade last year amounted to about £120,000, but this, of course, does not include glassware which was imported as semi-raw material and subsequently re-exported as part of a manufactured article represented as an export of British manufacture. This would particularly apply to mounting glassware, glass tubing and bottles. Indeed, the re-export of bottles and jars must be very considerable.

Though clause 1 of the new Bill exempts glass containers from compulsory marking in cases where the British trade mark appearing on the bottle might otherwise make it obligatory, nevertheless the way will be open by the Bill for British Glass Manufacturers to apply to the Board of Trade for an enquiry, having as its object the compulsory marking of all foreign glassware entering this country. No doubt such an application will be made, at any rate by certain sections of the industry, and the matter will have to be investigated in all its bearings by the Committee which the new Act will establish. When this time comes a great many facts and figures will no doubt be brought forward, in the light of which it should be possible to pass a more considered opinion than is possible at this stage.

At the time of going to press the Bill looked like being detained in the Standing Committee for some weeks. In any case it can hardly emerge until the latter part of July. It is doubtful whether there will be time for the Report Stage and Third Reading to be taken in the House of Commons before the House rises for the Summer recess. The Bill has to go to the House of Lords after the Commons give it a Third Reading, and there may be further delay in the Upper Chamber. It is therefore quite likely that the Bill will not reach the Statute Book until November. In this case the new tribunal can hardly get to work on special applications until the New Year, when there will certainly be a queue of applicants and progress will be slow, especially as the Bill now provides that twenty-eight days' notice must be given before the tribunal proceeds to deal with any particular application. When regulations begin to be issued as a result of the tribunal findings there will still have to be some months of notice before the new Orders come into force. This is quite proper, since extensive business arrangements will have to be made by the traders concerned. As a net result British manufacturers must not look to receive any benefit from the new Bill for a good many months to come. On the other hand they will no doubt be gratified to see the legislation effected.

◆

THE POTTERY AND GLASS TRADES BENEVOLENT INSTITUTION.

The 44th Annual General Meeting of this Institution originally fixed for the 12th May, was adjourned in consequence of the Strike to the 26th.

It was much regretted that absence abroad prevented The President, The Earl of Harrowby, from presiding, and in his absence, The Chairman of the Board of Management, Mr. Leather, took the Chair.

A very representative gathering listened with keen interest to the report which was further explained by Mr. Leather, especially that part which dealt with the need for the revision of the rules. The meeting unanimously endorsed the recommendation of the Board and the new set of rules were adopted and it is thought that they will be the means of considerably widening the scope and increasing the interest of those sections of the *Glass* industry which in the past appear to have had little interest in common with the work of the Institution.

The Accounts and Balance Sheet were to have been dealt with by Mr. G. E. Alexander, O.B.E., the Treasurer, but unfortunately at the last moment he phoned his inability to be present and in his place Mr. Stanley, The Chairman of the Finance Committee, dealt with that part of the work.

The meeting unanimously elected Mr. Stanley B. Bagley, J.P. (Chairman of Messrs. Bagley & Co., Ltd., Knottingley), a member of the Board, and re-elected to that body Mr. S. M. Stuart (Stuart & Sons, Ltd., Stourbridge) and Mr. F. B. Towers (Lewis & Towers, Dalston, E.)

Pensions of £36 and £24 respectively were granted to Mrs. H. Sanderson and Mr. W. W. Nixon.

Mr. G. E. Alexander, O.B.E., was appointed a Vice-President of the Institution and Webbs Crystal Glass Co., Ltd., added to the Vice-Presidents list.

Mr. Leather on his retirement from the Chairmanship of the Institution was presented with a Gold and Enamel Badge, a replica of the Portland Vase, as a small token of appreciation from his colleagues on the Board of his services rendered during his year of office.

At the Meeting of the Board of Management, immediately following the Annual General Meeting, Mr. C. J. Pratt (Governing Director of The National Glass Co., and Governing Director of the Rankin Automatic Glass Feeder Co.) was unanimously elected Chairman of the Board of Management for the ensuing year.

May Trade Returns.

IMPORTS OF GLASS AND GLASSWARE.

		Quantities.				Value.			
		Month ended 31st May.		Five months ended 31st May.		Month ended 31st May.		Five months ended 31st May.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod) ...	value	—	—	—	—	3,901	1,360	26,144	27,126
Glass Tubing and Rod for all purposes	cwts.	221	352	2,384	2,658	808	967	8,485	7,902
Illuminating Glassware	,,	11,563	6,805	54,409	55,562	28,485	20,297	142,563	158,846
Machinery Glassware	,,	22	7	102	29	434	46	1,243	298
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	48,332	36,543	228,452	237,811	128,280	105,178	620,652	660,796
Plate and Sheet Glass	,,	77,844	74,953	446 347	506,966	117,980	82,038	660,825	671,743
Optical Glass (other than worked Elements, *e.g.* Lenses)	,,	5	3	30	11	418	294	1,906	1,178
Bottles and Jars	gross	103,433	80,266	536,839	570,341	70,104	50,405	336,062	343,781
Glass and Glassware not elsewhere specified ...	cwts.	2,337	2,227	8,960	12,782	6,499	5,560	28,381	34,298
Total Value	£	—	—	—	—	356,909	266,145	1,826,261	1,905,968

EXPORTS OF GLASS AND GLASSWARE (BRITISH PRODUCTS).

		Quantities.				Value.			
		Month ended 31st May.		Five months ended 31st May.		Month ended 31st May.		Five months ended 31st May.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod) ...	value	—	—	—	—	5,740	4,960	29,162	28,644
Tubing and Rod for all purposes...	cwts.	273	523	1,425	2,234	2 470	2,556	10,574	13,185
Illuminating Glassware	,,	576	547	2,679	2,387	5,962	4,111	25,141	21,361
Machinery Glassware	,,	464	177	1,873	1.061	3,097	1,374	12,810	7,944
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	2,509	2,227	12,812	11,212	22,387	21,973	111,776	110,233
Plate and Sheet	,,	81,937	73,180	342,743	383,911	154,477	122,123	673,886	668,862
Optical (other than worked Elements, *e.g.* Lenses)	,,	13	9	60	26	153	138	1,396	597
Bottles and Jars	gross	26,066	17,141	139,007	118,605	27,549	18,119	142,937	117,012
Manufactures, not elsewhere specified	cwts.	852	599	3,508	3,357	5,038	3,313	19,079	20,174
Total Value	£	—	—	—	—	226,873	178,667	1,026,761	988,012

EXPORTS OF GLASS AND GLASSWARE (FOREIGN AND COLONIAL MERCHANDISE).

		Quantities.				Value.			
		Month ended 31st May.		Five months ended 31st May.		Month ended 31st May.		Five months ended 31st May.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod) ...	value	—	—	—	—	794	362	3,004	2,024
Glass Tubing and Rod for all purposes... ...	cwts.	2	—	7	8	46	2	102	93
Illuminating Glassware	,,	85	96	704	748	592	613	5,652	6,256
Machinery Glassware	,,	1	2	1	4	20	47	26	83
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	615	456	3,441	3,262	4,387	2,743	21,224	20,585
Plate and Sheet	,,	314	172	1,389	2,222	468	233	2,089	2,493
Optical Glass (other than worked Elements, *e.g.* Lenses)	,,	16	1	20	17	76	24	162	167
Bottles and Jars	gross	748	1,268	6,859	5,534	915	1,018	7,246	4,862
Glass and Glassware not elsewhere specified ...	cwts.	51	32	223	233	236	285	2,005	950
Total Value	£	—	—	—	—	7,534	5,327	41,510	37,513

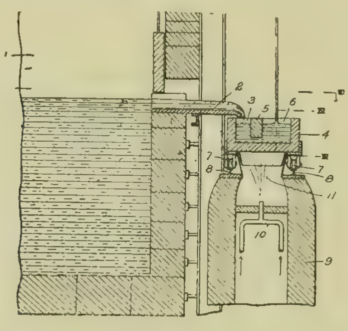
United States Patents.

GRANTED MAY 18, 1926.

1,584,728. **Method of Manufacturing Mirrors.** Theodore Willard Case, Scipio, N.Y., assignor to Case Research Laboratory Incorporated, Auburn, N.Y., a Corporation of New York. Filed April 18, 1922. Serial No. 555,526. 3 Claims. (Cl. 91—70.1.)

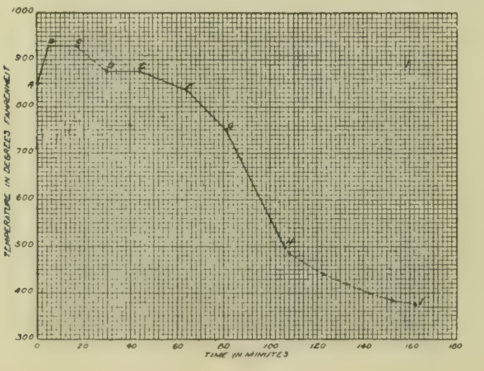
1. The method of manufacturing a mirror comprising removing water and vapour from the surface of a glass piece by baking and then depositing a metallic material in vaporised form upon the baked surface of the glass piece to form a thin coherent reflecting film thereon.

1,584,768.—**Manufacture of Sheet Glass.** Charles Henry Harding, Fort Smith, Ark. Filed February 8, 1926. Serial No. 86,680. 5 Claims. (Cl. 49—83.1.)



1. The method of manufacture of sheet glass which comprises developing the sheet from a body of molten glass and during the operation shifting the line of sheet-development in its own direction.

1,585,542.—**Process of Annealing Glass.** Kenneth M. Henry, San Francisco, Calif., assignor to Illinois-Pacific Glass Company, San Francisco, Calif., a Corporation of California. Filed November 25, 1924. Serial No. 752,110. 7 Claims. (Cl. 49—89.)



1. In a process of annealing glass articles in a temperature controlled lehr or muffle, the steps of subjecting the glass were to a plurality of annealing stages, first at a high temperature and thereafter at a lower temperature, all within the annealing range.

1,585,555.—**Method of Marking Glass.** Abdul Aziz Mansurzadah, Oakland, Calif. Filed July 23, 1925. Serial No. 45,701. 3 Claims. (Cl. 41—20.)

1. A method of marking glass and the like consisting of chemically modifying the hydroscopic properties of a portion of the surface thereof by applying thereto a chemical agent containing chromium in solution which reacts chemically with certain of the glass constituents to modify the hydroscopic properties of the treated surface, and thereafter exposing the agent to heat or light to complete the chemical reaction and the marking operation.

1,585,607.—**Process of Making Corrugated Wire Glass.** Walter Cox and Arno Shuman, Philadelphia, Pa., assignors to Pennsylvania Wire Glass Company, Philadelphia, Pa., a Corporation of New Jersey. Filed August 7th, 1920. Serial No. 401,925. 1 Claim. (Cl. 49—86.)

The process of making corrugated wire glass which consists in rolling a flat sheet of glass with flat wire mesh embedded therein, and while the interior portion of said sheet is sufficiently plastic by heat to permit the twists of the mesh to stretch and while the exterior of the sheet is sufficiently solid by cooling upon bending to retain its form, corrugating said sheet and mesh at one operation.

GRANTED MAY 25th, 1926.

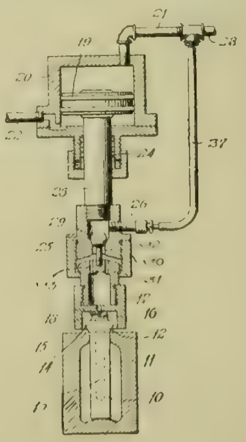
1,585,779.—**Production of Refractory Oxide Ware.** John Wesley Marden, East Orange, N.J., assignor to Westinghouse Lamp Company, a Corporation of Pennsylvania. Filed March 8, 1922. Serial No. 542,134. 30 Claims. (Cl. 18—47.5.)

1. An article of manufacture composed of thoria and resulting from shaping and fitting a mixture of thoria, cryolite, phosphoric acid and water.

1,586,008.—**Glass-Cleaning Composition.** Manuel A. Sevilla, Los Angeles, Calif. Filed May 14, 1924. Serial No. 713,221. 1 Claim. (Cl. 87—5.)

A glass cleaning composition in the form of a liquid consisting of the following ingredients in the proportions stated :—Powdered pumice stone, 1 part ; whiting 2 parts ; alcohol 1 part ; water 15 parts.

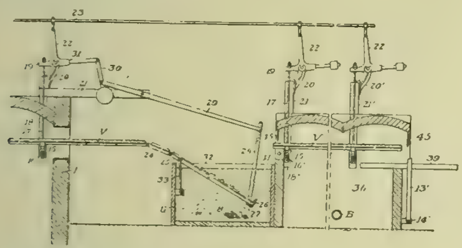
1,586,072.—**Method for Producing Grooved Cup Finish in Bottles and Article Produced Thereby.** Harry A. Crispin and Henry J. Pawling, Salem, N.J., assignors to Salem Glass Works, Salem, N.J., a Corporation of New Jersey. Filed June 19, 1925. Serial No. 38,186. 4 Claims. (Cl. 49—18.)



1. The method of forming a groove in a glass bottle

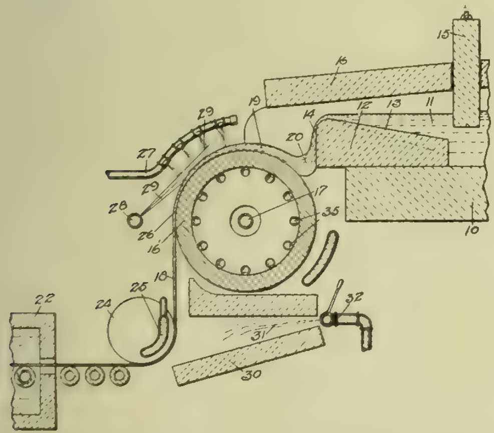
neck having an upstanding top or corking end rising from a flanged rim, which consists in telescoping said upstanding corking end into said rim while the glass is in semi-molten condition, to form a cup-shaped groove.

1,586,091.—**Method of and Apparatus for Handling Glass.** Charles W. Kurtz, Pittsburgh, Orah M. Byers, Kane, Louis R. Schmertz, Ligonier, and Lawrence A. Gessner, Jeannette, Pa., assignors to Window Glass Machine Company, Pittsburgh, Pa., a Corporation of New Jersey. Filed May 1, 1922. Serial No. 557,657. 8 Claims. (Cl. 49—1.)



1. In a glass handling apparatus, an interrupted glass-carrying means, a lehr through which one section of said means passes, a heating chamber through which another section of said means passes, and means between the lehr and heating chamber for dipping the glass carried by said means.

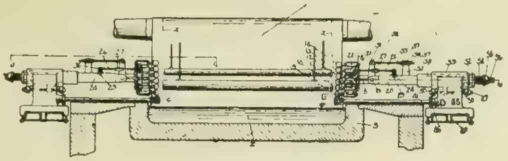
1,586,187.—**Method and Apparatus for Producing Sheet Glass.** Enoch T. Ferngren, Toledo, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed January 2, 1925. Serial No. 92. 6 Claims. (Cl. 49—17.)



4. In sheet glass apparatus, a furnace containing a mass of molten glass, a rotatable drum, means for permitting a flow of glass to pass from the furnace upon the drum in a manner that it will tend to move on the drum in a direction opposite to its rotation, and means for drawing a sheet from the glass on said drum, the sheet being drawn in the same direction as that of rotation of the said drum.

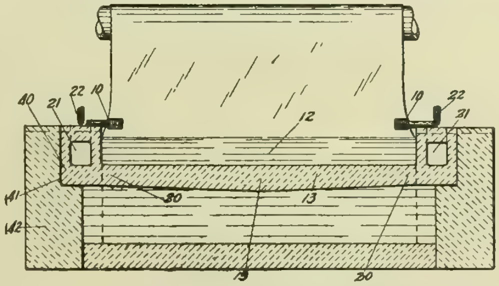
GRANTED JUNE 1st, 1926.

1,586,618.—**Method and Apparatus for Drawing Sheet Glass.** Enoch T. Ferngren, Toledo, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed July 7, 1922. Serial No. 573,292. 27 Claims. (Cl. 49—17.)



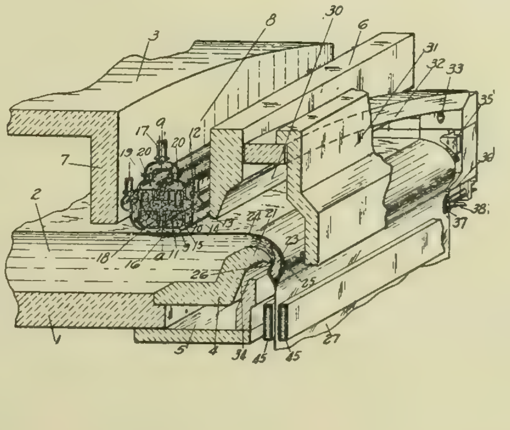
1. In the art of drawing sheet glass from a mass of molten glass, the method of maintaining lateral tension in the sheet during the formative period, consisting in forming thickened edge portions on the sheet at the sheet source, gripping the thickened portions between rolling surfaces after they have passed beyond their place of formation and immediately adjacent thereto, and holding the sheet against its tendency to contract.

1,586,619.—**Method and Apparatus for Supplying Molten Glass to Sheet-drawing Machines.** Enoch T. Ferngren, Toledo, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed October 12, 1922. Serial No. 593,961. 11 Claims. (Cl. 49—17.)



3. In an apparatus for drawing sheet glass, wherein the sheet is drawn upwardly from a rather deep pool of molten glass, means for segregating a shallow body of the molten glass below and adjacent the sheet source, comprising a submerged refractory plate with its upper surface substantially parallel with the surface of the pool, the plate having a substantially flat upper surface but being thicker at the centre than adjacent the sides of the pool, for the purpose described, and heating chambers contained within the ends of the plate.

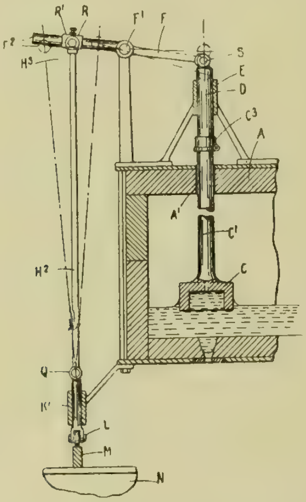
1,586,620.—**Method and Apparatus for Continuously Drawing Sheet Glass.** Enoch T. Ferngren,



Toledo, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed October 11, 1922. Serial No. 593,884. 16 Claims. (Cl. 49—17.)

1. The method of producing sheet-glass wherein a layer of cooler plastic glass is congealed upon a portion of the surface of a pool of liquid glass, this layer being reheated and then floated over the edge of the containing receptacle upon a film of liquid glass and drawn away in sheet form.

1,586,704.—**Apparatus for Controlling the Delivery of Glass from Furnaces to Molds and the Like.** James Dennis Roots, London, England. Filed September 25, 1920. Serial No. 412,747. 3 Claims. (Cl. 49—55.)



1. An apparatus of the character described including a receptacle for containing molten glass, said receptacle having a discharge opening therein, a plunger mounted to reciprocate relative to the receptacle and for controlling the discharge of glass through the opening, said plunger including a hollow stem and an enlarged recessed head, the hollow stem allowing the exhaust of air from the head whereby glass may be received in the recess of the head at all times, and means for raising and lowering the plunger, said plunger when being raised creating a vacuum to raise the glass and cut off discharge thereof through the opening and when being lowered discharging the glass through the opening.

1,587,171.—**Recuperator Structure for Furnaces.** William A. Morton, Pittsburgh, Pa., assignor to The Amsler-Morton Company, Pittsburgh, Pa., a Corporation of Pennsylvania. Filed October 9, 1922. Serial No. 593,195. 18 Claims. (Cl. 72—15.5.)

1. In a recuperative structure for furnaces, the combination of a plurality of vertically disposed air flues, each flue being composed of a plurality of vertically disposed flue tile in superimposed relation, and horizontally disposed flange tile interposed between adjacent alined flue tile and socketed above and below to receive the ends of the flue tile, and said flange tile being provided with integral lateral projections, the projections of adjacent flange tile being in engagement to brace the associated air flues against lateral displacement.

BRITISH PATENTS.

The following abstracts are taken from the Illustrated Official Journal of Patents with the special permission of the Controller of H.M. Stationery Office.

Printed copies of the full specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C., price 1/- each.

249,536.—**Heat Exchangers.** Chavanne, L., 18, Avenue du Président Wilson, Paris. March 19, 1925, No. 7443/26. Convention date, March 19, 1924. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Classes 51 (i), 51 (ii), and 64 (i).)

FIG. 5.

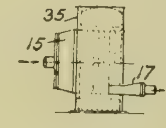


FIG. 6.

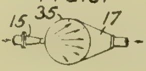


FIG. 7

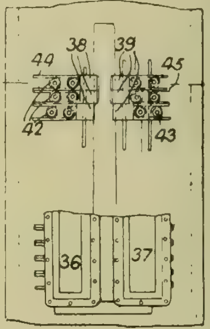
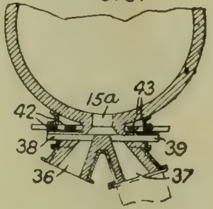


FIG. 8.



Regenerators; gaseous-fuel furnaces; air and gas heating furnaces; dampers.—Continuous heat exchange apparatus is provided with narrow elongated inlet and outlet ports for the heating fluid to equalise the distribution of the heat. The width of the ports may be adjustable at different points along the length. The heat exchanger 35 has a vertical slot-like port 15 giving good distribution parallel to the axis and a horizontal port 17 serving a large part of the periphery. Figs. 7 and 8 show a gas-fired heater having a long narrow vertical slot 15*a* supplied with air and gas from ports 36, 37 the supply being regulated by a series of sliding dampers 38, 39. These dampers may comprise refractory bricks mounted for movement by means of rollers 42, 43 running in channels 44, 45. For heating with waste gases one of the ports 36, 37 is dispensed with. The slot 15*a* may be horizontal, the dampers being then maintained in position by counterweights. The nest of tubes within the heater may be rotated and may be provided with internal and external refractory masses.

249,543.—**Silica Stones.** Schüller, N., Ehrenbreitstein, near Coblenz, Germany. March 18, 1926, No. 7525. Convention date, March 20, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 22.)

Refractory substances containing silica.—Waste sands, such as those obtained from the glass industry and from grinding and washing processes in general are used instead of quartzite, etc., in the manufacture of silica stones. The substances may be mixed with slaked lime with or without organic binders and with or without pieces of quartzite, and subjected to the action of superheated steam, hot gases, or hot air. The material is said to undergo rapid conversion into tridymite during the baking process.

249,636.—Annealing-furnaces. Frazier, C. E., 417, East Beau Street, Washington, Pennsylvania, U.S.A. February 9, 1925. No. 3591. (Class 51 (ii).)

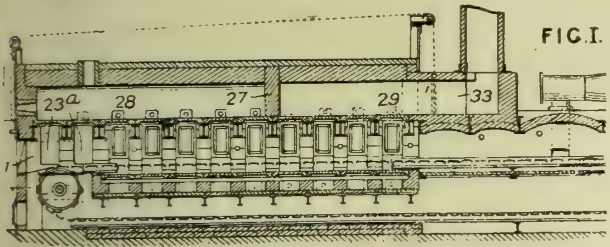


FIG. I.

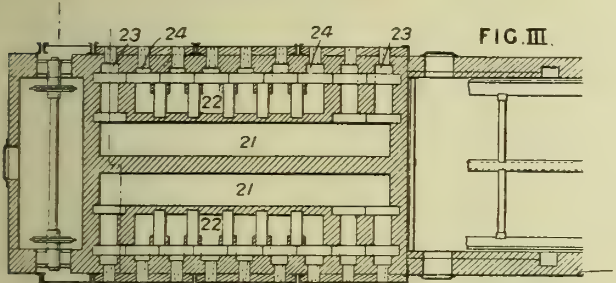


FIG. III.

In an annealing-leer of the kind in which a combustion chamber disposed above the lehr muffle communicates through side wall flues with longitudinal flues beneath the floor, the side wall flues near the lehr inlet, and those more remote therefrom are connected to different floor flues. In the construction shown, the chamber above the muffle 1 is divided by a partition 27 into a combustion chamber 28, and a flue chamber 29, and both chambers communicate through damper-controlled side wall flues 23, 24 with four longitudinal floor flues consisting of an inner pair 21 and an outer pair 22. At each side of the lehr the flue 22 is connected with the combustion and flue chambers through four flues 24 on one side of the partition 27, and two flues 24 on the other side, while the three flues 23, 23*a* at the inlet end of the lehr, and the two at the flue end, communicate with the flue 21. The flues 23*a* above the conveyer sprockets are connected with the adjacent side wall flue 23 by small horizontal flues. The side wall panels of the flues 23 are preferably made of cast iron instead of tile as in the main body of the lehr. The chamber 29 is divided by a longitudinal partition 33 into two chambers, which communicate by separate damper-controlled openings with the chimney.

249,695.—Bottles. Bartlett, A. E., 321, Fulwood Road, Sheffield. May 19, 1925. No. 13020. Drawings to Specification. (Class 125 (i).)

Sediment, retaining; shaped to facilitate cleaning.—In a bottle provided with the usual flat base, the interior, from about half its length to the base, is substantially cone-shaped, the cone end being pointed or nearly so, so that sediment collects at the end of the cone and remains there whilst the contents of the bottle are being poured out. According to the Provisional Specification, the shape facilitates the cleaning of the bottle. Specification 5091/81 is referred to.

249,797.—Electric Incandescent Lamps. General Electric Co., Ltd., Magnet House, Kingsway, London.—(Assignees of Patent-Treuhand-Ges, für Elektrische Gluhlampen; 11, Ehrenbergstrasse, Berlin.) February 27, 1926, No. 5623. Convention date, November 14, 1925. (Class 39 (ii).)

Bulbs of clear glass are coloured or rendered light-diffusing by coating their internal surface with transparent or translucent powder. This may be blown into the bulbs, or passed into them as fumes from burning metal, and the operation may be performed on a sealing-in machine. The powder may consist of white or coloured oxides, sulphides, etc., of metals such as magnesium, aluminium, silicon, zirconium, titanium, tantalum, iron, or chromium.

249,863.—Glass Manufacture. Heuze, C., Auvelais, Belgium. March 23, 1926, No. 7994. Convention date, March 28, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)

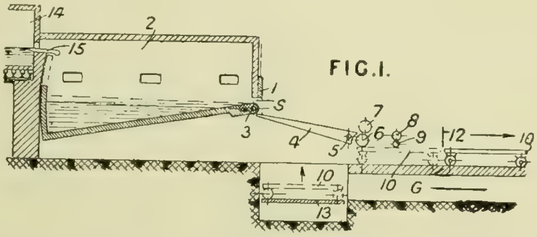


FIG. I.

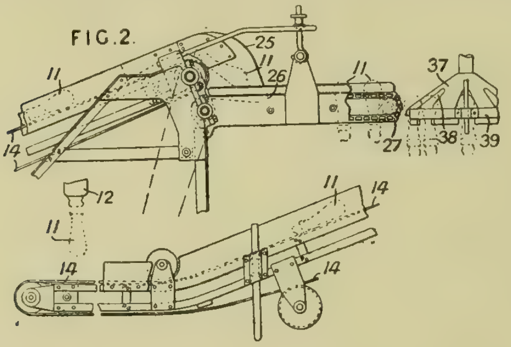
Delivering molten metal; rolling.—Relates to the method of making plate-glass in which the metal flows from the melting-tank on to the rolling apparatus. According to the invention, a storage tank is interposed between the melting-tank and the rollers, and charges of metal are drawn from the storage tank as required. The metal issuing from the storage tank also flows over an inclined forming-table before passing between the rollers.

Delivering molten metal.—In the construction shown in Fig. 1, the metal is made in a tank 14 and flows through a spout 15 into a storage tank 2 the bottom of which is pivoted on an axis 3 situated near an outlet slot S. The bottom can be moved by suitable means and when it is raised metal is discharged through the outlet S, a gate 1 being provided to assist in controlling the discharge. The bottom may be fixed instead of being movable, and the outlet slot may be formed in the bottom and closed by a gate. In another modification the storage tank may be made to rock about a transverse or a longitudinal axis, the tank being tilted when it is required to discharge metal. In a further modification, the outlet slot is formed in the side of the storage tank and the axis about which the tank is tilted passes close to the slot, so that the movement of a pouring-lip, which is attached to the slot, is reduced to a minimum when discharging metal. The trunnions about which the form of tank turns are made hollow, and one is used to admit metal while the other serves as an inlet for the gas used for heating the tank.

Rolling.—Metal issuing from the outlet S in the tank 2 flows over an inclined table 4 to rollers 6, 7 by which it is formed into a sheet. The table is pivoted on an axis 5 close to and parallel with the rollers, and its inclination can be adjusted. The sheet, as it leaves the rollers 6, 7, is led by carrier rolls 8, 9 on to a conveyer table 10 which moves under the rollers at the same speed as that of the sheet of glass. A shearing-device 12 cuts the sheet into lengths which are conveyed by the moving table 10 to a lehr. After removal of the glass, the table returns through a tunnel 6 and is raised by an elevator 13 into position to be run under the rollers to receive a new sheet. The table 10 may be returned along a parallel truck instead of through a tunnel.

249,868.—**Glass Manufacture.** British Thomson-Houston Co., Ltd., Crown House, Aldwych, London. —(Assignees of Brown, C. A. ; 1854, Burnett Road, East Cleveland and Sickle, F. B Van ; West Brook Drive, Wickliffe, both in Ohio, U.S.A.) March 24, 1926, No. 8069. Convention date, March 24, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)

FIG. 2.



Transporting ware.—Relates to a machine for conveying electric lamp bulbs or similar articles, from the machine by which they are formed to a finishing machine, such as that described in Specification 151,771. The device comprises an endless travelling belt 14 which receives bulbs 11 as they drop off a part 12 of the forming machine and conveys them to a shoot 25 whence they fall to a second conveyer 26. This consists of two endless travelling belts 27, parallel with one another and spaced such a distance apart as to engage the widest part of a bulb and allow the neck to hang downwards. The bulbs are transported by this conveyer to a loading-mechanism consisting of a continuously rotating carrier disc 37 provided with peripheral pockets 38 for receiving the bulbs. A guard strip 39 extends partly around the disc 37 to prevent the bulbs from falling out of the pockets 38. Pivoted fingers are mounted on the disc 37 behind each of the pockets, and these fingers are operated by a fixed cam to push the bulbs out of the pockets as they arrive opposite the loading-station of the finishing-machine.

249,919.—**Regenerators.** Teisen, T., 20a, Temple Street, Birmingham. December 31, 1924 No. 31,299. (Class 51 (i).)

A tubular brick *t* of substantially uniform wall thickness for heat transfer purposes is provided at each end with co-axial hexagonal flanges of unequal lengths, one flange *b* having a spigot and the other *a* a corresponding socket, such bricks together with end tubes and spacing pieces *d* being built up to form recuperators in which one gas passes through the tubes and the other around them, or regenerators in which the gases pass only around the tubes. The intermediate part between the flanges may also be of hexagonal shape and may be provided on two opposite pairs of side walls with external teeth *c* to break up the fluid stream. For each horizontal layer the direction of the bricks *t* is reversed so that they are bonded due to the unequal lengths of the flanges. The distance pieces *d* each have the shape of a quadrant of the hexagonal flange, and are provided with grooves filled with cement to prevent leakage. End tubes of two different lengths are provided so that the end walls come flush. In Fig. 10, *i*, *j* are the inlet and outlet passages for air passing upwardly in a zig-zag path around the bricks, which are set so that for every vertical channel there are two inclined channels causing a further mixing action. Waste gases pass through the tubes, being baffled by division slabs *o*, and teeth similar to the teeth *c* may also be provided within the tubes. The area of passage for the air may be increased as the air expands by making the recuperator broader at the upper part.

FIG. 10.

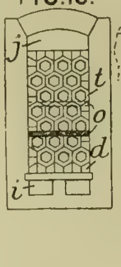


FIG. 3.

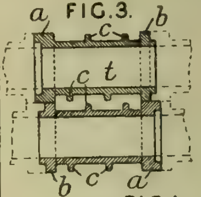
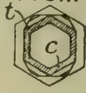
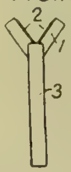


FIG. 1.



250,064.—**Severing Glass.** Bello, F. F., 58, Mollet Del Valles, Barcelona, Spain. June 25, 1925, No. 16348. (Class 31 (i).)

FIG. 1.



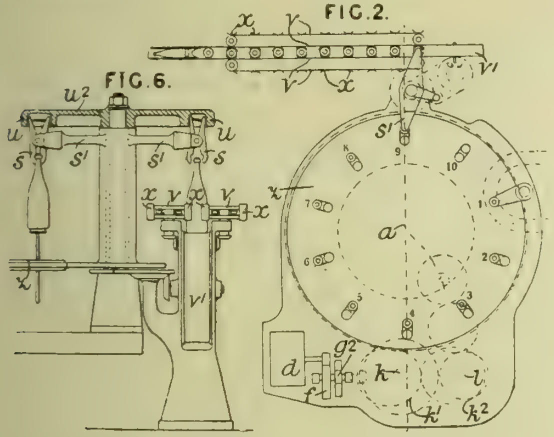
A device for severing glass tubes, rods, decanters, etc., comprises a handpiece 3 having parts 1 forming a V-shaped opening, the opposed faces of the parts 1 carrying extended surfaces 2 of carborundum, quartz, etc. The piece to be severed is placed in the opening and relative rotation is imparted to the piece and the device whereby a groove is cut in the piece. One of the surfaces 2 may be formed with teeth, the other being plain.

250,192.—**Glass Manufacture.** Renodier, J. E., 139, Boulevard Antoine Gautier, Bordeaux, Gironde, France. March 2, 1926, No. 5896. Convention date, March 31, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)

Blowing.—Relates to an automatic bottle-blowing machine in which the moulds revolve continuously about a central column, and consists in providing a driving-mechanism which varies the speed of rotation during each revolution and also a take-off device for removing the finished bottles from the machine.

Driving.—The invention is shown applied to a machine of the turnover-parison type in which the moulds are mounted on a table z, Fig. 2, that rotates about a vertical axis a. The table is driven from a motor d through a train of gearing, a friction clutch being interposed between the gear wheels f and g^2 in order to relieve the motor in case the mechanism should become jammed. Two of the gear wheels k^1, k^2 are elliptical and are mounted eccentrically on their shafts k, l, respectively, so that the shaft l is driven at a speed that varies relatively to that of the shaft k. The ratio of the gearing is so arranged that a mould is travelling at a lower speed as it reaches the charging position and during the turn-over operation.

FIG. 6. FIG. 2.



Formed article, removing.—The finished article is removed from the machine by a gripper s, Fig. 6, carried by an horizontal arm s^1 which is rotated in unison with the table of the machine. The grippers have tailpieces which engage in a circular track u of varying width formed in a fixed plate u^2. The bottle is deposited by the gripper on a travelling belt v^1, and is supported by curved plates x which are secured at intervals to v arranged alongside and driven by the belt v^1. The conveyer carries the finished bottles to the lehr.

250,200.—**Glass-annealing Lehrs.** Hartford-Empire Co., 333, Homestead Avenue, Hartford, Connecticut, U.S.A.—(Assignees of Ingle, H. W., 96, Evergreen Avenue, Hartford, Connecticut, U.S.A.) March 13, 1926, No. 7043. Convention date, March 31, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Classes 51 (ii) and 78 (i).)

FIG. 1.

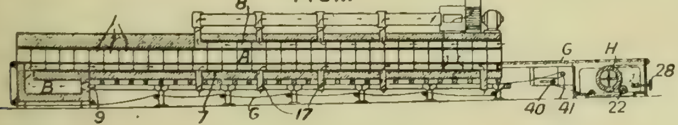
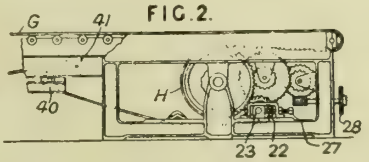


FIG. 2.



Retort, muffle, and like furnaces; tunnel furnaces; charging and discharging; air supplying.—In a glass-annealing lehr, of the kind having heating flues beneath the floor, the goods are carried through the lehr on an openwork conveyer-band resting on the floor. As shown, the lehr comprises a tunnel A built up of sections 1 and having heating flues 7, extending beneath the whole length of the floor, and cooling flues 8 incorporated in the roof structure towards the discharge end. The conveyer G is built up of interconnected wires 48, Fig. 4, of helical form, and, in order to counteract the tendency to "creep," the band is formed of alternate sections 49, 50, Fig. 6, respectively woven of right and left hand helixes. The conveyer driving-mechanism comprises a sprocket-wheel 28 adapted to drive, through gearing, a rubber or like covered drum H and a similarly covered roller between which the band G passes, the roller being journalled in slide blocks 23 and pressed into contact with the drum H by jack-screws 27. A belt-tightening device is provided consisting of relatively movable rollers 40, 41. The fire-box B is heated by a burner 9 and the hot gases, before passing to the flues 7, are tempered by admixture with cold air, further damper-controlled inlets 17 being provided throughout the length of the flues 7 for the admission of air to cool the gases and so obtain the required temperature gradient.

FIG. 4.

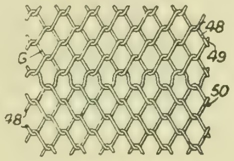
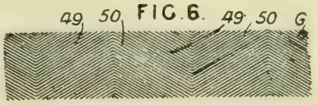


FIG. 6.



250,201.—**Annealing Glassware.** Hartford-Empire Co., 333, Homestead Avenue, Hartford, Connecticut, U.S.A.—(Assignees of Mulholland, V., 119, West Main Street, West Hartford, Connecticut, U.S.A.) March 13, 1926, No. 7050. Convention date, March 31, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 51 (ii).)

Glass furnaces; tunnel furnaces; retort, muffle, and like furnaces; charging and discharging; air supplying; casings and walls; expansion fittings.—A tunnel lehr for annealing glassware is provided with heating flues C extending beneath the whole length of the floor and with cooling flues D, incorporated in the roof structure and extending from the discharge end for about two-thirds of the length of the tunnel, the temperature gradient in these flues being adjusted by admitting air, for diluting the heating gases, through one or more of the spaced inlets 55 and by withdrawing the cooling air from the flues D through one or more of the spaced outlets 50 which deliver into a common conduit 49. The pipes 50, 55 are fitted with dampers 51, 56, and a motor-driven fan 41, communicating with a box 42 which is connected to the conduit 49 and by vertical passages 43 with the heating flues C, is provided for drawing the hot gases and cooling air through their respective flues at sub-atmospheric pressure. The tunnel A is built up of metal sections bolted together, the front section being secured at 8 to a box 9 forming an extension of the combustion chamber B and the remaining sections being supported, to permit longitudinal expansion, by rollers 12 which rest on rails 13 secured to the main girders 1. The framework 1, 2 is adjustably mounted on vertical pillars 3 and is so disposed that the tunnel inclines slightly from the hotter to the cooler end. The heating and cooling flues C, D are constituted by cells 7, 19, Fig. 3, formed integral with the floors 4 and roofs 6 of the tunnel sections, the sides 5 of which are secured by spacing-bolts 65 to an outer casing 64 having expansion joints 67 and between which and the tunnel is disposed heat-insulating material 61 such as powdered kieselguhr.

FIG. 1.

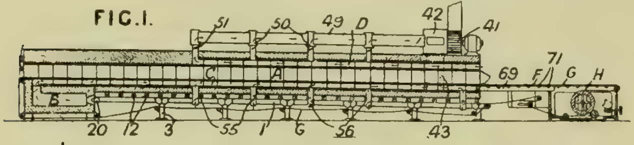


FIG. 2.

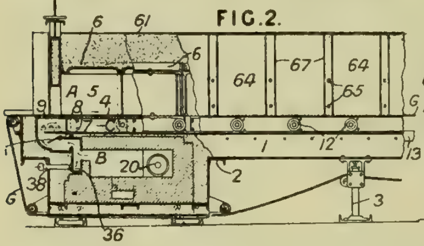
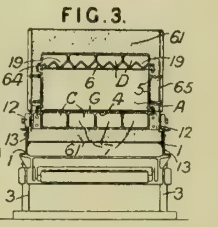


FIG. 3.



The combustion chamber B is fired by a burner 20 and the hot gases, after traversing a box 36 to which air is admitted through pipes 38, enter the box 9 fitted with a regulating damper. The ware is carried through the lehr on a flexible openwork conveyer G supported directly on the floor 4 and driven by mechanism H; at the discharge end of the lehr the conveyer passes over a sorting-table F comprising two side members 69 connected by a number of transverse anti-friction rollers 71.

250,299.—**Glass Manufacture.** Hall, R. F., Tanners Green, Wythall, near Birmingham. October 21, 1924, No. 32,021/23. (Class 56.)

FIG. 1.

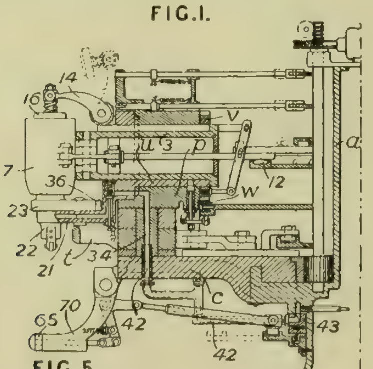
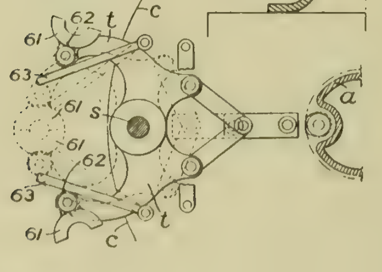


FIG. 5.



Blowing.—Relates to a bottle making machine of the turnover type in which a number of sets of parison and finishing moulds are carried by a table that rotates, preferably continuously, about a stationary central column. Each mould carrying unit comprises a casting *p*, Fig. 1, which is secured to the rotary table *c* and has its lower part formed as a trunnion *s* on which the arms *t* of the finishing mould are journalled. The casting is formed with a horizontal boring within which a sleeve *u* is mounted so that it is free to rotate but cannot move longitudinally. A toothed wheel *v* secured to the sleeve engages an interrupted circular rack *w* secured to the stationary central column *a*, so that the sleeve is periodically rotated as the table *c* rotates. A second sleeve 3 is mounted within the sleeve *u* and is constrained to rotate with it, but it is free to move longitudinally. This sleeve carries the halves 7 of the parison mould which are opened and closed by a roller 12 and a cam fixed to the central column *a*. The sleeve 3 also carries an arm 14 provided with a cover 16 which closes the bottom of the parison mould at appropriate times. The blowing-head 22 is carried by an extension 21 of the sleeve *u*, and the halves 23 of the ring mould are pivoted on the extension 21. The blowhead is connected, by a passageway 34 in the casting *p* and by pipes 42, with a distributing-ring 43 by which suction or compressed air is applied to the blow-head. The passage 34 is closed by a spring-loaded valve 36, and both this valve and the mandrel for making the initial opening in the blank are operated, as the mould 7 is turned over, by cams secured to the casting *p*. The halves 61, Fig. 5, of the finishing mould are pivoted on the arms *t*, and they carry pinions 62 which gear with racks 63 mounted on the table *c*. Thus as the mould is opened, the halves rotate in their pivots in order to give clearance for the parison mould. In operation, a gob of metal falls into the parison mould and suction is applied to the blowhead to settle the metal into the ring mould. The cover 16 is then applied to the mould, and the rotation of the sleeve *u* turns the mould over, and the parison is blown-up during the rotation. The parison mould halves are opened, and are then drawn back towards the central column, this movement, which gives clearance for the finishing-mould, being accomplished by the movement of the sleeve 3 longitudinally within the sleeve *u*. A mould bottom 65 is brought up against the parison, the finishing mould is closed, and the blowing-operation is completed. The bottle is finally discharged on to a belt conveyer which is travelling at the same linear speed as the bottle. The bottom 65 may be made movable in its support 70 in order that bottles with "pushed" bottoms may be made. The neck mandrel may be arranged to form the necks of the bottles with internal screws.

250,462.—**Glass Manufacture.** Pollak, J. E., 20, Holborn, London.—(Owens Bottle Co., Nicholas Building, Toledo, Ohio, U.S.A.) September 8, 1925. No. 22468. (Class 56.)

Blowing; taking-in devices.—Relates to a device for receiving bottle or other glass articles as they are delivered from a forming machine and for transferring them to a conveyer or other support. The device is designed particularly for use with a machine in which a number of bottles are delivered at approximately the same time, and it comprises a number of guides each of which receives a bottle and keeps it out of contact with other bottles. The forming-machine has two finishing-moulds 11, Fig. 2, mounted on each of its arms 12, and each finishing mould is formed with three mould cavities so that six bottles are formed simultaneously by each set of moulds. As the moulds are opened near the discharging-position, the bottles are supported by a pair of knock-out arms 14, each of which carries discs *a* . . *e*, Fig. 7, that press on the mouths of the bottles. When these arms are lifted and swung apart by a cam 85, Fig. 2, the bottles are released and fall into funnels 33 forming part of the delivering device. The knock-out discs *a* . .. *e*, Fig. 7, are adjusted so that they assume different levels when lifted off the bottles. With this arrangement, the bottles are not released simultaneously but at different periods in quick succession. The funnels 33 each comprise a stationary section and a swinging section 31 which is supported and rocked by a shaft 37 in time with the movement of the forming-machine. The bottles are received from the machine and held, and then are released simultaneously by the movement of the sections 31. The bottles thus released fall into a shoot 25 which comprises a number of troughs or guideways separated from one another by walls. The bottles slide down these troughs on to a conveyer belt 63 by which they may be carried into the lehr, and the walls prevent them from touching one another and sticking together. The shoot 25 is so supported that it may be moved up and down, and towards or away from the machine.

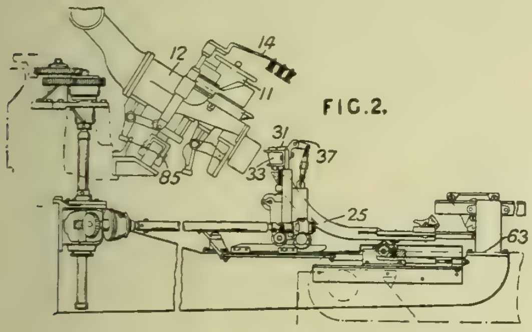


FIG. 2.

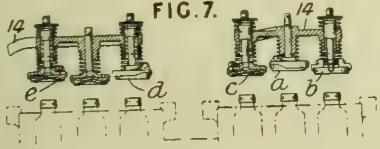
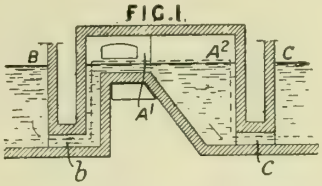


FIG. 7.

250,536.—**Glass Manufacture.** Soc. Anon. des Manufactures Des Glaces et Produits Chimiques de St. Gobain, Chauny, et Cirey, 1^{bis,} Place des Saussaies, Paris. February 5, 1926, No. 3383. Convention date, April 10, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Classes 51 (ii) and 56.)

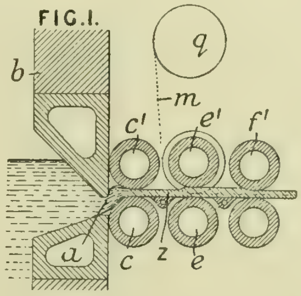
Production of metal.—A method of fining molten glass consists in flowing it from the melting end, B, of the furnace to the working end, C, through a lining chamber the floor of which is at two different levels, the first part of the chamber being shallow. Glass from the lower levels of the melting end B flows through one or more conduit *b* into the shallow part A^1 of the fining chamber, which is kept at a higher temperature, and the glass being in a shallow stream is heated uniformly while in the part A^1. It then passes into the deeper part A^2 of the fining chamber, which is kept at a lower temperature, and passes into the working end C through a passage *c* formed near the bottom. The sides of the part A^2 preferably taper towards the passage *c*. The conduits *b* may be heated electrically, and other parts of the chamber may be heated or cooled as necessary.

FIG. I.



250,537.—**Glass Manufacture.** Soc. Anon des Manufactures des Glaces et Produits Chimiques de St. Gobain, Chauny, et Cirey, 1^{bis,} Place des Saussaies, Paris. February 6, 1926, No. 3483. Convention date, April 11, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)

FIG. I.



Rolling.—Relates to a method of making wire glass in which molten glass is rolled into a continuous sheet and wire netting, supplied continuously, is introduced into the sheet while it is being formed. In the construction, shown in Fig. 1, glass issuing from a slot *a* in the wall of a tank or forehearth *b* is formed into a sheet Z by rollers *c*, c^1, as described in Specification 241,206. Wire netting *m* unwound from a roll *q*, is pressed into the sheet by a grooved roller e^1 acting in opposition to a roller *e*. The furrows formed in the sheet by the roller c^1 are pressed down and closed by a roller f^1, and the finished sheet is fed into a lehr. In a modification, the rolls *c*, c^1 are omitted, the rolls *e*, e^1 being placed close against the slot *a* so that the netting is fed into the sheet while it is being formed. In another construction two sheets are formed from two separate tanks and these sheets are rolled together by rollers to form the finished sheet, the wire netting being sandwiched between the two sheets as they pass between the rollers. The two slots may be formed in the bottom of a tank or forehearth, instead of in separate tanks. Rollers may be used to impress a pattern on the finished sheet if desired. The construction also enables the finished sheet to be made of two layers of different colours.

Latest British Patents.

Applications for Patents.

12331.—May 13, 1926. J. K. Frazer. Gas scrubbing and washing apparatus.

12434.—May 14, 1926. C. F. Kenworthy. Annealing etc. furnaces.

12685.—May 18, 1926. H. C. Shewell. Bottle-openers.

12920.—May 19, 1926. A. McKim. Glass-cleaners.

12977.—May 21, 1926. J. E. Riley. Poison bottles, etc.

13146.—May 25, 1926. (Germany, September 19, 1925). W. O. p. Rieck (Firm of) vorm. Crown Cork Co., Ltd. (Hamburg Branch). Bottle stoppering machines.

13205.—May 25, 1926. (United States, June 24, 1925). Hartford Empire Co. Apparatus for feeding molten glass.

13304.—May 26, 1926. A. Symmons. Closures for non-refillable bottles.

13340.—May 26, 1926. L. Mellersh-Jackson (Hartford Empire Co.). Apparatus for feeding molten glass.

13475.—May 27, 1926. (Pennsylvania Wire Glass Co.). Manufacture of wire glass.

13515.—May 28, 1926. G. H. Bennett. Hermetic closures for jars, etc.

13539.—May 31, 1926. L. Mellersh-Jackson (Hartford Empire Co.). Forming sheet glass.

13557.—May 28, 1926. B. Laporte Ltd., I. E. Weber. Closure for bottles.

13641.—May 29, 1926. (January 26, 1925). E. Hope. Manufacture of glass etc. objects.

13729.—May 31, 1926. L. Mellersh-Jackson. (Hartford Empire Co.). Forming sheet glass.

13735.—May 31, 1926. (France, March 19, 1926). Soc. Anon. d'Etudes et de Constructions d'Appareils Mecaniques pour la Verrerie. Machine for manufacturing bottles, etc.

13748.—May 31, 1926. L. Mellersh-Jackson. (Hartford Empire Co.). Forming sheet glass.

13751.—May 31, 1926. L. Mellersh-Jackson. (Hartford Empire Co.). Forming sheet glass.

13760.—May 31, 1926. L. Mellersh-Jackson. (Hartford Empire Co.). Forming sheet glass.

13847.—June 1, 1926. (United States, June 1, 1925). British Thomson Houston Co., Ltd. Purification of quartz.

13850.—June 1, 1926. (France, September 5, 1925). Soc. Anon. des Ateliers de Construction et Fonderies de Jeumont, Anciens Etablissements T. Haut. Manufacture of plate glass, etc.

14209.—June 4, 1926. (Empire Machine Co.). Shaping or feeding glass.

14312.—June 7, 1926. R. G. Slee. Mineral water syphons.

14407.—June 8, 1926. J. H. S. Dodwell. Manufacture of bottles, etc.

14494.—June 9, 1926. A. G. O. Strong. Bottles, etc.

14528.—June 9, 1926. W. M. Bergius. Bottle closures.

14664.—June 10, 1926. (Germany, August 1, 1925). Patent Treuhand-Ges fur Elektrische Gluhlampen. Insulators formed from glass.

14770.—June 11, 1926. (Germany, August 1, 1925). Patent Treuhand-Ges. fur Elektrische Gluhlampen. Production of glass for insulating, etc.

14813.—June 12, 1926. Kapella Ltd. Lens systems.

15245.—June 17, 1926. R. W. Barrett. Bottle cap and lock.

15393.—June 18, 1926. F. Turck. Key for opening bottle caps.

15416.—June 18, 1926. British Hartford Fairmont Syndicate Ltd. T. Wardley. Apparatus for feeding molten glass.

Specifications Published.

228924.—February 7, 1924. E. Roucka. Furnaces.

232625.—April 19, 1924. J. Paisseau. Supports for use in the manufacture of glass or enamel beads.

241184.—October 13, 1924. Chemische Fabrik Griesheim-Elektron. Process for the production of practically iron-free alumina.

245071.—December 27, 1924. A. L. Anderson. Combined bottling, corking and labelling machine.

247918.—February 17, 1925. P. Liese. Composite glass and ferro-concrete coverings or structures for ceilings, floors, walls, and the like.

247926.—February 18, 1926. P. Muller and K. Rahlwes. Method and means for capping bottles.

251167.—March 19, 1925. R. Urmston. Syphons or containers for soda-water and the like.

251745.—March 27, 1925. W. A. Woodrow. Bottles.

252817.—March 12, 1925. C. F. Kenworthy. Annealing and like furnaces.

252867.—May 12, 1925. T. V. Blake. Process and apparatus for washing or scrubbing coal or like gas.

252868.—May 12, 1925. Dr. A. L. Mond (E. H. Peabody). Apparatus for the combustion of elastic and/or liquid fuels.

252869.—May 12, 1925. Dr. A. L. Mond (E. H. Peabody). Apparatus for the combustion of gaseous, pulverised, or similar fuels.

252937.—August 10, 1925. British Kork-N-Seal Agency, Ltd. and J. N. Steuart. Lids for bottles, jars, and similar containers.

252956.—September 28, 1925. F. W. Golby (Libbey Owens Sheet Glass Co.). Sheet glass drawing apparatus.

252964.—October 7, 1925. J. F. Sargent and J. C. Wootton Devices for applying closures to bottles or other containers.

Specifications open to Public Inspection.

251951.—May 11, 1925. Naamlooze Vennootschap Philips' Gloeilampenfabrieken. Sealing metal in or to glass.

252372.—May 19, 1925. Hartford Empire Co. Method of and apparatus for making hollow blown glassware.

253067.—June 3, 1925. A. Baudino. Polishing discs.

253093.—June 6, 1925. H. Matthey. Machines for cutting fancy watch glasses.

253494.—June 11, 1925. M. Bicheroux. Methods and devices for manufacturing plate glass.

Patents, Trade Marks, Inventions.—Advice, Handbook and Consulsations free. King's Patent Agency, Ltd., Director B. T. King, C.I.M.E.; Regd. Patent Agent, G.B., U.S., and Canada, 146a, Queen Victoria Street, E.C.4, and 6, Quality Court (near Patent Office), London, W.C. 39 years' references. 'Phone: Cent. 682.

The Proprietors of Letters Patent No. 199375 relating to improvements in Screw Closures for Glass Containers, desire to dispose of their Patent or to grant licences to interested parties on reasonable terms for the purpose of exploiting the same and ensuring its full commercial development and practical working in this country.

Enquiries to be addressed to CRUICKSHANK & FAIRWEATHER, Chartered Patent Agents, 65-66, Chancery Lane, London, W.C.2.

SYPHONS.

Wanted to Purchase, Glass Vases for Mineral Water Syphons in large quantities. Advertiser would pay cost of moulds, etc., for English manufacture.—Thos. Mayo & Co., Ltd., 12, King's Road, St. Pancras, London, N.W.1.

The Owners of British Patents No. 189493 entitled "Sheet Glass Drawing Machine," No. 189494 entitled "Improvements in and relating to Sheet Glass Drawing and Delivering Mechanisms," No. 189495 entitled "Method of Making Sheet Glass," No. 189496 entitled "Apparatus for Drawing Sheet Glass," No. 191097 entitled "Method and Apparatus for Drawing Sheet Glass," and No. 192427 entitled "Sheet Glass Drawing Mechanism," desire to dispose of the same or would grant a licence to work the inventions on royalty terms. Particulars may be obtained from TECHNICAL RECORDS, LIMITED, of 59-60, Lincoln's Inn Fields, London, W.C.2.

GLASS

THE RECOGNIZED ORGAN OF THE GLASS INDUSTRY
Published on the Tenth of Each Month.

Single Copies - - - - One Shilling
Annual Subscription - - 10/6 post free

GLASS PUBLICATIONS Ltd.
TECHNICAL PUBLISHERS,
Talbot House,
Arundel Street,
Telephone: CENTRAL 5985. **Strand, London, W.C.2.**

CONTENTS.

	PAGE
Editorial	355
Refractories for the Glass Industry (*continued*).—By W. J. Rees, B.Sc., Tech., F.I.C. (Lecturer in Refractories, University of Sheffield)	356
Conchoidal Glass Fractures: A Microscopical Investigation.—By James Scott, M.S.C.I., M.E.H.A.	358
Practical Notes on the Thermal Endurance of Glass.—By H. V. E. Renn	360
The Selection of Electric Motors	367
The Use of Compressed Air (*continued*).—By Robert Wilson	371
An Australian Glass Works	375
U.S. Tariff on Plate Glass	375
Trade Notes	377
The "How and Why" of Pyrometer Resistance	379
A New Type of Filter for Oil Fuel	384
Seeds in Glass	386
Industrial Designs Competition	386
Pavement Lights	387
Merchandise Marks Battle.—By Our City Correspondent	388
June Trade Returns	389
United States Patents	391
British Patents	395
Latest British Patents	400

Editorial Notes.

At the commencement of the coal dispute the opinion amongst the men and also a considerable proportion of the general public was, that unless negotiations between the conflicting parties were successfully concluded within a comparatively short period, the result would be an almost complete closing down of other industries, with the consequent industrial paralysis of the whole of the country. Doubtless it was this hope which sustained and encouraged the miners' leaders to continue their attitude of hostility towards anything but the "all or none" policy they had adopted. Apparently they were under the impression that the prospects of such a complete stoppage would result in them obtaining the terms and conditions they demanded, or in other words, the dispute was to be settled, not by the economic merits of the case they put forward, but by a species of blackmail of other industries.

No one can, or will desire to minimise the disastrous effects on the country's prosperity of this unfortunate cessation of work at the pits, but at the present time there are sufficient statistics and information available to show in a most decided manner that the conditions are not quite so bad as was at first anticipated they would be.

Foreign coal is coming in in ever increasing quantities naturally to the benefit of those countries which previously we considered our most keen competitors. A lot of it is admittedly poor in quality and exhorbitant in price, but nevertheless many factories and works are managing to continue production by its use. Oil fuel, of course, has been adopted in innumerable instances (to be retained, in many places, even when the dispute is finally settled). In general it would seem as if the lowest point of the depression curve had been reached and passed, and that matters were gradually readjusting themselves to the changed conditions and showing some improvement every day.

In common with those of other industries whose productive requirements necessitate an adequate supply of cheap fuel, many glass manufacturers have suffered severely. Some of them whose stocks of fuel were high, or who have been willing and able to pay the price demanded for the imported coal, as well as those who were already using oil, have been able to carry on successfully, whilst others have installed oil burning equipment and are still in operation, though in many cases on a reduced scale. In spite of this, however, a considerable number have had to close down, in some cases taking advantage of the occasion to effect modifications and repairs to plant and equipment.

The Board of Trade returns for the month of June are really a cause for congratulation under the circumstances, as although our exports in glassware for the month show a reduction of 2½ per cent. in value over June, 1925, they are far in excess of what were generally anticipated. In the case of plate and sheet, tubing and rod, they actually show an increase. On the other hand the imports are in excess of June, 1925, the increase being 30 per cent.

At the moment every one is concerned with what may be termed the immediate cost of this upheaval, but we should not lose sight of the fact that our troubles of the present day may possibly prove ultimately to be of material advantage and value. There is a considerable amount of truth in the old adage "Necessity is the mother of invention," so that the scheming and devising of ways and means now, may result in improved processes and methods for the use of fuel in the future, and be the great incentive to study the more economic use of combustibles which, owing to the abundant and cheap supply previously available, has been lacking.

[GLASS *will deal with all matters pertaining to the industry in an impartial manner, consequently the Editor does not necessarily associate himself with the opinions expressed by his contributors.*]

Refractories for the Glass Industry.

By W. J. REES, B.Sc., Tech., F.I.C. (Lecturer in Refractories, University of Sheffield).

(Continued.)

Silica Refractories.

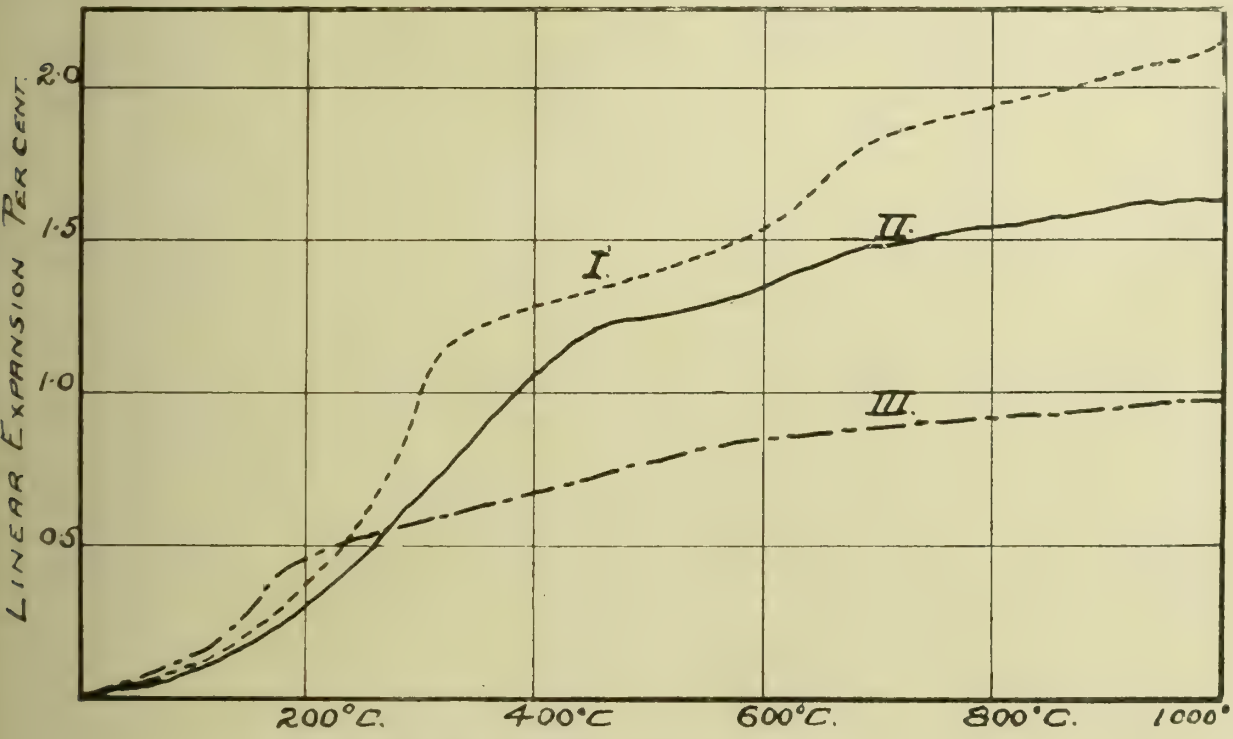
The *powder density* of silica bricks for use in furnace construction should not exceed 2.38, and for the crown, where it is particularly desirable that excessive after-expansion should be avoided, it should not be higher than 2.35. As will be emphasised later, the use of well-burned silica bricks necessitates considerable care in the early stages of the heating of a furnace, but their greater stability and durability much more than compensates for their sensitivity at low temperatures.

Texture.

Assuming a satisfactory chemical composition and refractoriness, the durability of the silica brick in service will largely depend on its texture. The size and shape of the fragments of silica and the ratio of these fragments to the matrix have a marked influence on the behaviour of the brick. In particular, it must be noted that the concentration of the lime silicates is dependent on the surface area of the silica fragments in contact with the added lime. It is, consequently, important that whether the texture be coarse, medium or fine it should be uniform throughout the brick and throughout a batch of bricks used in the construction of any particular part of a furnace. Bricks which are coarse in grain and of open-texture are, in general, more resistant to abrupt changes in temperature than those of medium or fine texture, but these latter are more resistant to the penetrating action of such fluxes as batch dust. Bricks of fine texture should be selected for use in ports and regenerator fillings, because of their higher resistance to the abrading action of hot dust-laden gases. The fragments of silica should be angular so as to offer the maximum surface-area to the lime bond and give the maximum mechanical strength, and the heat-treatment of the brick during its manufacture should be such as to effect recrystallisation of the silica in the matrix. The greater part of this recrystallisation is effected during the high-temperature *soaking* stage of the burning of the brick. There will be a tendency for bricks of fine texture and low porosity to be of lower refractoriness than coarse-textured bricks made from the same raw material with the same proportion of bonding material, as when a larger proportion of the total surface of the silica fragments is in contact with the bonding material there will be a quicker "vitrification" at a high temperature. From close observation of the behaviour of bricks of very varying textures and with porosities varying between 25 and 35 per cent. in glass-melting furnaces, the author has concluded that the maximum durability of the crown and walls is obtained with well-graded bricks of medium texture and a porosity of about 28 per cent. In ports, regenerators and recuperators, bricks of finer texture are preferable, but they should still contain a good proportion of fragments from one-eighth to three-sixteenths of an inch in size in order to sufficiently retard the rate of vitrification. Uniformity in texture is particularly important in regard to the size and distribution of the pore-spaces in the brick. The available information does not permit any generalisation as to the effect of varying texture and porosity on the spalling tendency of silica bricks. It would be expected that the more porous bricks would be less susceptible to spalling, and, as indicated above, it is found, in general, that bricks of coarse texture are less affected by rapid changes in temperature than those of fine texture, but the author has observed, on occasion, that with bricks of similar grain-size, the more porous ones have shown a greater spalling tendency, especially when the pores have been of small dimensions. With careful treatment in the early life of the furnace, well-graded bricks of medium texture will give good service in glassmaking furnaces, will present no spalling difficulties, and will be more efficient than bricks of coarse texture. The thermal conductivity and heat capacity of silica bricks increase with their apparent density so that higher efficiency will be obtained from close-textured bricks in regenerator fillings. The apparent density (or volume-density) of silica bricks varies between 1.65 and 1.85 ; a medium-textured brick of good quality will have an apparent density of about 1.70. A useful check on the uniformity of deliveries in this respect can be obtained by noting the net weight of trucks of bricks and calculating to the weight per thousand bricks.

Thermal Characteristics.

The expansion of a silica brick during its life in a furnace is of two principal orders. There is, first, the temporary (or reversible) expansion, which is compounded of the ordinary thermal expansion plus the α—β inversions of the crystalline silica present; and second, the permanent expansion due to the inversion to tridymite or cristobalite of any quartz in the brick. Le Chatelier's investigations showed that the α—β inversion in quartz at 575° C. involves a linear expansion of about 0.4 per cent., in cristobalite at 240° C. of about 1.0 per cent., and in tridymite at 150° C. of about 0.15 per cent. The curves in the figure on p. 357 are drawn from observations on three different bricks, I being of medium texture containing approximately 40 per cent. of unchanged quartz and very little tridymite ; II of medium texture containing approximately 15 per cent. of unchanged quartz and 10 per cent. of tridymite ; III a brick of medium texture which had been specially burned for 10 times the normal time and containing very little unchanged quartz, most of its silica being inverted to tridymite. The rapid increase in the rate of expansion which occurs at the α—β inversion temperatures in quartz and cristobalite is shown by these curves. Bricks of the mineralogical composition of No. III are not at present a commercial possibility. Numerous experiments have been made in the effort to find a catalyst which will accelerate the rate of inversion to tridymite at kiln temperatures without adversely affecting the refractoriness and other essential characteristics of the bricks but, so far, the results are not such as are likely to lead to the early commercial production of the all-tridymite brick. It is only on maintaining the kiln temperature for very prolonged periods at 1450°—1500° C. that the quartz and cristobalite are inverted to tridymite, and, consequently, the cost of producing the all-tridymite brick would be out of proportion to its advantages of freedom from the inversion expansions, as these expansions are without deleterious effect if adequate care is taken in the heating of the furnace. *For practical purposes it may be considered that the better burned the silica brick is, the greater is the need for care in the very early stages of heating the furnace in which the bricks are in use.* Although less thoroughly burned bricks may be less sensitive to damage through rapid heating of the furnace, their permanent expansion during the high temperature life of the furnace is very disturbing and may seriously affect its working. The change in contour of the crown of a tank-furnace which may result from the use of badly-burned bricks may materially alter the conditions of combustion or the direction of the flame in the furnace and so adversely affect the rate of melting. The total reversible expansion will vary with the relative proportions of quartz, tridymite and cristobalite present and also with the texture of the brick. With an open-textured brick some of the thermal expansion is accommodated within the structure of the brick. With good quality bricks of medium texture and porosity 26 to 30 per cent., the reversible expansion up to 1500° C. is from 1.4 to 2.0 per cent. It is necessary therefore to allow for this expansion, which may be as much as five-sixteenths of an inch per foot, by slackening the tie-rods during the heating of the furnace. Too rapid heating, especially in the often-inappreciated low temperature range, 200°—300° C., or neglect to relieve the expansion stresses, results in the setting up of a tangential strain near the hot face, which may be of such magnitude as to cause a fracture or spall. Such fractures generally leave a more or less spherical surface. It is worth while observing the actual rise of the crown of a furnace by taking measurements between the bricks and horizontal cross-wires stretched between the brickstaves; the number of screw-threads let out in the tie-rods should also be counted. The safest method of heating a furnace built largely of silica bricks is by means of special small coal-fired grates built externally at the foot of the regenerators, using a very small draft to pull the warm gases through the checkers and the furnace.



I.—Quartz, 40 per cent.; Cristobalite, 60 per cent.
II.—Quartz, 15 per cent.; Tridymite, 10 per cent.; Cristobalite, 75 per cent.
III.—Quartz, 5 per cent.; Tridymite, 95 per cent.

It has been generally considered that the co-efficient of thermal conductivity is larger for silica than for fireclay bricks. A. T. Green,[*] however, as the result of a number of careful experiments, considers that most fireclay bricks have a slightly higher true thermal

---

[*] Trans. Inst. Gas. Eng. 1921-22, 195

[Continued on page 369.

Conchoidal Glass Fractures.

A Microscopical Investigation.

By JAMES SCOTT, M.S.C.I., M.E.H.A.
(Author of *The Microscope in the Mill*).

Watch the concentric wave-rings travelling outwards from a centre of disturbance on the surface of a pond, after a pebble has been thrown into the water, and you can learn the secret of the formation of the familiar conchoidal fractures discernible in broken glass.

The water is, we will say, absolutely still to begin with. Suddenly there is a violent shock as the stone strikes the medium. If the water were, instead, a pasty, or thick, unyielding substance, the force of impact would leave a cup-like depression, or crater, somewhat larger than the object to which the upset of equilibrium was due. Simultaneously, lines of reaction, which are visible in *solid* materials, would be undiscernible, owing to becoming absorbed, as it were, by the rapid re-settlement of the parts.

Water, however, being a liquid, the cavity is soon filled in once more, but the energy thus occasioned rushes outwards in all directions, and so causes the unrolling, from the folded central area, and we observe the well known waves. The latter, as they increase in diameter through distant uprise and fall, are naturally strained radically. This phase will be better understood by supposing that we have a sheet of india-rubber, or some equally flexible stuff, suspended so that stresses or concussions may easily be demonstrated. Throw a stone into the middle part of the sheet, and the missile will push the portion struck downward—if the sheet is fixed horizontally; or away from the thrower—if it is hung vertically. But the substance will fly back to its original position, and also slightly beyond it to the fore, and then go back again, repeating a series of slight vibrations until it is once more perfectly level.

Substitute something which will not rebound, and then throw the stone—a layer of dough or putty would be suitable for this purpose—and a hollow space will be the result, because there is no chance for the stuff to vibrate or shake.

Now, bear in mind, that as the stone sinks into the water the diverging, or splitting, action gradually loses its power.

It is evident that when a sheet of *anything* receives an impact, the tendency thereof is for it to assume a basin-like form. If the sheet is flexible it vibrates to and fro until it finally comes to rest again. If it is liquid the vibrations induce a rippling upwards, and outwards, from the focus of disarrangement. If it is solid (like glass) it cannot respond, except to a meagre degree, to such influences, and since (as the inner parts are thrown backwards) the outer parts are, of course, bent forward, and having no means of accommodating themselves to altered circumstances (such as wholly pliable stuff has) it is split radially from centre to circumference—hence we can account for the conspicuous "*starring*" of glass panes, etc.

If we imagine that the glass *could* be pressed basin-like after striking in the manner outlined, the cracks would be semi-circular (or arc-like) from the hole, or depression, or centre of attack, with a disposition to assume a wholly spherical formation if the glass happened to be sufficiently thick for it to do so.

In this way we can explain how it is that a glass fracture reveals the *radial* strokes, or delicate fissure, But if we microscopically examine a series of selected graduated fractures, it will be seen that there are not only *radial* cracks, but concentric ones in addition. Indeed, the latter are the more notable ones in most examples, and are responsible for imparting the shell-pattern (i.e., conchoidal marks) to the substance. Now, the same effects which are detectable from *radial* operations—when these lines are viewed sideways, and thus become *curved*—are traceable to similar causes as those responsible for the existence of the concentric rings on water, and so forth. That is to say, they have emerged, so to speak, from a nucleus of knock, as miniature waves (or vibrations), which, being unable to subside, or to continue to settle down again, have left their mark permanently as a row of concentric circles. There is really no limit to the fineness of the lines capable of being thus produced, and, in consequence, permanently fixed for ready observation.

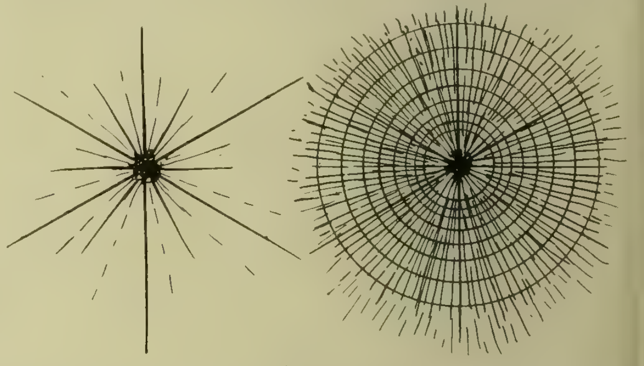


Fig. 1.
Diagrammatic views of the "starring" of glass, with consequent conchoidal fracturing, simple cracks (first) and compound ones (second).

The same law which is demonstrated on the surface of water when ripples have been occasioned thereon are brought into operation when glass is cracked—namely the widening rings *strain* the substance, in order to accommodate themselves to the best possible advantage, and thus allow the substance to regain its former *status* as a resting medium. It is obvious that as the outer waves have less power, or strength, than the inner ones, the latter have the greater facility for accepting the larger amount of "*pull*"; and thus the splitting, or "starring"—so distinctive in glass—is more sharply defined in the middle sections than it is elsewhere, and gradually weaken until the lines become imperceptible towards the borders of the regions concerned.

Glass, being practically rigid—its slight degree of elasticity only enables the beginning of the process to emphasise all the facts of structural modification to be evolved—the waves created by dislocation of the original particles become ineradicably fixed; and so we have them available for inspection at any time.

It should be remembered that, if we could secure a completely symmetrical figure of such really simply formed results, it would resemble one of the old-fashioned wire gas-globes, which consisted of a number of wires bent to produce an open-work sphere, round which were wound, or placed, a lot of wire rings, some smaller than the others, at right angles to the first mentioned. Suppose that a globe of this character had companions fitting inside it, closely, the dimensions of the inner ones being less and less until the central one was really tiny, and you would secure a very fair model (on an enlarged scale) of the formation which is brought about in glass when it is fractured. In other words, the wires in such a case could be regarded as representing the "*fixed*" waves, or vibrations, which occur in glass; and if such a compound globe could be cut across in *any direction*, it would disclose a design very much like the conchoidal fractures, which arise *always* in cracked, broken, or chipped glass. There would be the concentric rings, bearing straight lines passing radially through them, the straight lines being really curved ones viewed from above. But in this case the pattern would be more symmetrical, or perfect, because it would be a prepared one. In glass, as we do not need telling, the shock-effect is haphazard; therefore the result in such pattern is somewhat varied, although it is satisfactorily distinctive.

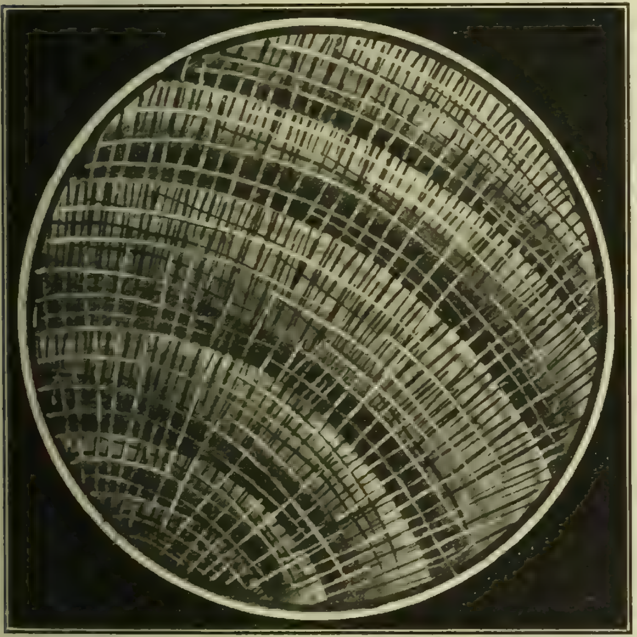


Fig. 2.

Magnified view of a conchoidal glass fracture. To the naked eye it appeared as a mere chip on the edge of a broken pane.

Although glass fractures are sometimes quite visible to the unassisted vision as "*conchoids*," it must be understood that there is no limit to the number of *radial* lines, nor the *concentric* ones; nor to their delicacy. Indeed, personally, I think that the best examples for study are those which, to the bare eyes, are disclosed as mere chips, since the observer can, in a manner of expressing it, get right down to the fundamental features; and, of course, however big a fracture happens to be, it is actually composed of a host of smaller ones combined together. When we examine, through the microscope, a "*shell*" figure quite perceptible to ordinary sight, the same figuring can be easily traced right down to minute scales.

In some cases (possibly due to the presence of tiny granules, globules, or crystals in the glass) the "*conchoids*" are arranged in overlapping bunches, in rows, or maybe only in irregular formation. But each little chip discloses the characteristic pattern, brought into existence by means of correspondingly insignificant agencies.

A reference to the illustrations will help to explain my preceding remarks. In Fig. 1 is a diagrammatic rendering of the way in which lines (or slender cracks) are produced in "shocked" glass.

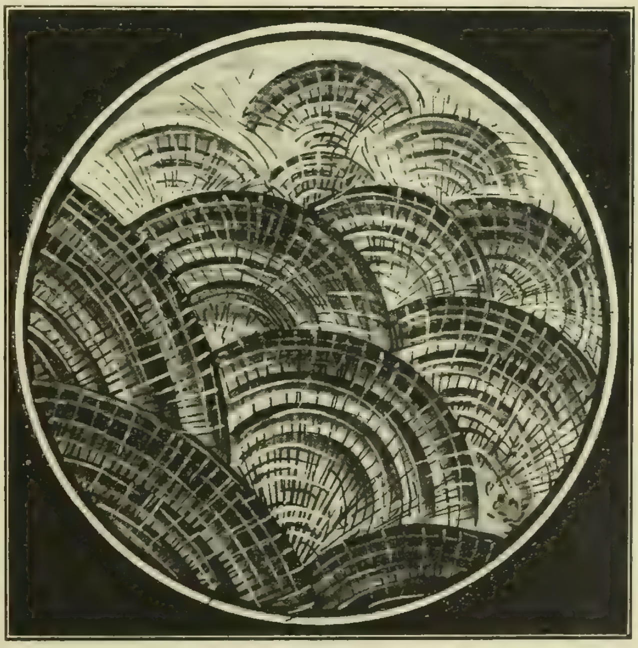


Fig. 3.

Magnified view of a compound glass fracture disclosing very effectively the characteristic conchoidal fracturing.

In Fig. 2 is shown a small fracture, magnified, of simple formation; while in Fig. 3 can be seen one of the compound specimens.

The foregoing particulars account for the fact that Triplex glass is resistant to breakage—the initial waves, or ripples, produced by direct impact of a missile, bring about a reverse action in the piece of glass opposed against the one which is struck, and thus equilibrium is regained, the celluloid film in between them both serving to pass off the shock, while holding the split pieces together. In ordinary glass these responsible actions are impossible; and thus it shivers and fractures;

Practical Notes on the Thermal Endurance of Glass.

By H. V. E. RENN.

The properties discussed in previous articles upon this subject are the following :—Thermal expansion and conductivity, elasticity, tensile and compressive strengths and hardness. The significance of the specific heat of a glass with relation to the property expressed by the term thermal endurance will now be briefly considered.

Specific Heat.

Specific heat is defined as the ratio of the quantity of heat necessary to raise a unit mass of a substance through a temperature of one degree to the quantity of heat required to raise the temperature of an equal mass of water one degree. If one gram is taken as a unit of weight, then, since the unit of heat adopted is that quantity which will raise one gram of water one degree, the specific heat of a substance is numerically equal to the fraction of the unit of heat necessary to raise one gram of that substance one degree.

From the above definition it is possible to arrive at a very simple explanation of the effect of the specific heat of a glass upon thermal endurance. Given two glasses, A and B, the specific heat of A being low and that of B high, a comparatively smaller quantity of heat would be required to raise a mass of the glass A to a given temperature than would be required for an equal mass of glass B under the same conditions. Also, if the two glasses were exposed to equal quantities of heat, the temperature difference would be greater in the case of glass A. Assuming the mechanical and remaining thermal properties that influence thermal endurance to be identical in the case of both glasses, then because A is the more effected by exposure to changes of temperature, it follows that it would contain the greater amount of stress and is therefore more liable to fracture. From this it is obvious that a high specific heat value is desirable in glass.

The most usual and at the same time simplest method of determining the specific heat of a substance is known as the method of mixtures, and consists in heating a known mass of the substance to a known temperature and then immersing it in a vessel, termed the calorimeter, containing a known mass of water. The initial and final temperatures are noted by means of a thermometer immersed in the calorimeter water. An expression is then found for the quantity of heat which has been given up by the hot substance and which involves its specific heat. The heat given out by the substance during immersion has raised the temperature of a known mass of water together with that of the calorimeter and the thermometer through a known number of degrees, and a second expression is found involving only these known quantities. In equating these two expressions for the same quantity of heat, it is possible to determine the specific heat of the substance. Various corrections have to be applied if accurate results are required. These will be briefly stated in their appropriate order.

The apparatus required for a specific heat determination by the method of mixtures consists essentially of (a) the calorimeter and the device termed the stirrer, for mixing the contents, (b) the jacket enclosing the calorimeter, (c) the thermometer for measuring the rise in temperature of the water, and (d) the apparatus for heating the substance under test.

The calorimeter is invariably made from pure or nickel-plated copper. In any case it should be highly polished on the outside in order to diminish as much as possible the loss of heat due to radiation.

The stirrer is intended to fulfil the dual purpose of maintaining a steady circulation through the calorimeter and of mixing the contents. The stirrer adopted by White in his investigations* on the specific heat of silicates at high temperatures were similar in form to that shown in Fig. I. It consists of a screw, A, which revolves in a tube attached to the main body of the calorimeter at the top and bottom. By means of this arrangement it is possible to keep the calorimeter at a uniform temperature while the heat is being rapidly given out by the substance immersed.

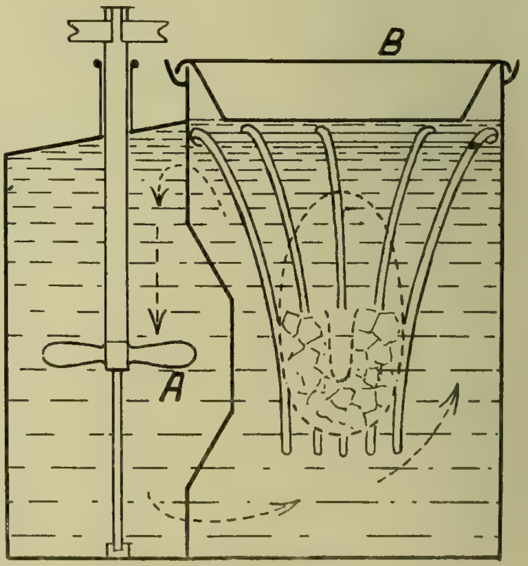


Fig. 1.

The cover, B, is intended to be in actual contact with the calorimeter water in order to minimise temperature differences. It should also fit closely so that loss due to evaporation through the crevices does not exceed a few milligrams per hour. A loss of this order is not likely to lead to any serious error in the result.

---

*Phys. Rev. xxxi, 1910.

The surroundings of the calorimeter should be kept at as constant a temperature as possible. In some experiments water-jackets have been used, but an accurate temperature regulator is preferable. The calorimeter should be suspended or supported on non-conducting supports inside a polished jacket to protect it from sudden changes of atmospheric temperature such as would be caused by a draught. The transference of heat between the calorimeter and the jacket needs careful consideration, for it is invariably the case that there is a lowering of the final temperature of equilibrium. Eighty per cent. of the heat transfer is due to convection and air conduction, while radiation and evaporation are responsible for the remainder. It is often recommended that the space between the calorimeter and the jacket should be packed with some insulating material—cotton-wool is usually mentioned in this regard. Although the loss of heat is greatly reduced, the method possesses certain disadvantages. There is primarily the danger of the packing absorbing moisture, which would lead to serious error due to loss of heat by evaporation, while another objection is that bad conductors require a considerable time to reach a steady state, and on this account a deal of uncertainty attends their use. By far the more reliable method is that adopted by Dickinson.* Three supporting points are each made up of a brass cone soldered to the bottom of the jacket. while on the end of each cone is cemented an ivory tip about 2 millimetres wide. These tips coincide with three small plates on the bottom of the calorimeter.

The error due to loss of heat is one that has to be carefully guarded against. Heat is lost in transferring the hot substance to the calorimeter, and although it can be considerably reduced, it can never be entirely eliminated, neither can it be accurately allowed for by arithematical corrections. Heat is lost when the temperature of the calorimeter exceeds that of its surroundings and, as has already been pointed out, there is a lowering of the final temperature of the mixture by the escape of heat during the time occupied in attaining equilibrium. These errors are such that can be allowed for fairly accurately by calculation.

A method, in which the heat loss is accounted for by determining the temperature which the body would have attained had there been no loss, is due to Ferry, who advanced proof of its reasonable accuracy. A graph is prepared, Fig. II, in which time is plotted horizontally and temperature vertically. Let C represent the temperature of the surroundings and let a body at a temperature below this be given a quantity of heat such that its temperature rises to a value above C. The temperature changes that take place before the addition of the heat are represented by the curve AB, while the line BD shows the temperature changes due to the absorption of the heat. From B to C the body is, in addition, receiving heat from the surroundings and from C to D is losing heat to the surroundings. The temperature changes due to radiation, etc., alone, are indicated by the curve DE. The construction is as follows: Through C draw a vertical line. Extend ED until it meets the vertical in f. Similarly, extend AB until it meets the vertical in h. Then the temperature changes are given by the line h, f.

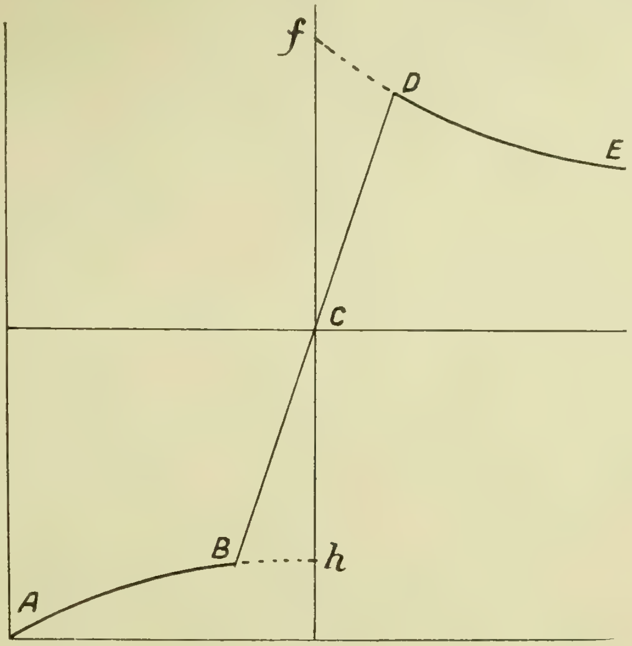


Fig. 2.

Calculation of Specific Heat.

The method consists in heating a known mass of the substance under test to a known temperature and then immersing it in the calorimeter containing a known mass of water. Let M be the mass of the substance, $t_1°$ its temperature and c its specific heat, W the mass of the water, $t_2°$ its temperature initially and $t_3°$ the common temperature of the water and substance after the latter has been immersed. The mass M is cooled from $t_1°$ to $t_3°$ and the quantity of heat evolved is therefore

$$Mc(t_1° - t_3°)$$

The calorimeter and the water, together with the stirrer and the thermometer are raised from $t_2°$ to $t_3°$ and the heat necessary for this is

$$W(t_3° - t_2°) + w(t_3° - t_2°)$$

where w is the quantity of heat required to raise the temperature of the calorimeter, stirrer and the thermometer one degree, which is numerically the same as the water-equivalent of the calorimeter. Since all the heat lost by the substance inmmersed is used in raising the temperature of the water, calorimeter, etc., these two quantities of heat must be equal. Hence

$$Mc(t_1° - t_3°) = (W + w)(t_3° - t_2°)$$

and

$$c = \frac{(W + w)(t_3° - t_2°)}{M(t_1° - t_3°)}$$

The term "water-equivalent" has been used. This is the product of the mass of the calorimeter and the specific heat of the material of which it is made and represents the quantity of water which would require the same quantity of heat to raise its temperature one degree as does the calorimeter. This quantity can be determined experimentally as follows. The calorimeter is first weighed empty, then about half filled with water and weighed again. Let m be the increase in the mass observed, that is the mass of water in the calorimeter, and let $t_1°$ be the temperature of the water. The experiment is performed by adding hot water at a known temperature (say 30°) and observing the rise in temperature. Proper precaution, of course, has to be taken to ensure that no loss of heat takes place during the pouring of the hot water into the calorimeter. Let the temperature of the hot water be $t_2°$ and the final temperature after mixing $t_3°$. The calorimeter and contents are weighed once more, in order to ascertain the mass of hot water which has been added. Let the increase in weight be m_1, then the heat given out is

---

* Sc. Paper Bur. Stds., 1914, No. 230.

$$m_1(t_2° - t_3°)$$

and this quantity of heat has been used to raise the temperature of the calorimeter, thermometer and stirrer, that is, the mass m from $t_1°$ to $t_3°$. Let w, as before, be the required water-equivalent, then the heat required to do this is

$$m(t_3° - t_1°) + w(t_3° - t_1°)$$

and this must be equal to the heat given out by the hot water in cooling. Hence

$$m(t_3° - t_1°) + w(t_3° - t_1°) = m_1(t_2° - t_3°)$$

and

$$w = \frac{m_1(t_2° - t_3°)}{t_3° - t_1°} - m.$$

In carrying out this determination it is important that the apparatus should be under the same conditions as when determining the specific heat.

The method outlined above was used by the present writer to determine the specific heat of the soda glass used in the manufacture of graduated flasks. During investigations upon the various errors introduced in the calibration of these vessels, it was decided to determine the extent of the error involved when water at a comparatively low temperature is run into the flask at a much higher temperature. The amount of expansion undergone by the liquid was first determined by direct measurement and then afterwards indirectly by determining the specific heat of the glass of which the flask was made. This value, when multiplied by the mass of the flask, gave the water-equivalent of the flask. Using this figure, it was a comparatively simple matter to compute the expansion undergone by the water, applying, of course, the correction necessary for the contraction of the flask during the fall from the initial temperature to that of equilibrium. The results thus obtained were comparative with the determinations carried out by direct methods.

In the determination of the specific heat of a substance by the method of mixtures, the quantity of heat is measured by the effect produced on the materials involved and despite elaborate precaution error is almost invariably introduced. In recent years, however, the electrical method has come into extensive use, in which a definite and easily measurable amount of electrical energy is converted into heat and the resulting change of temperature observed. The electrical method has to some extent superseded the former method of determining specific heats since it possesses the advantages of great accuracy and facility of control. Using the method it is also possible to determine the true specific heat of a substance, that is, the specific heat over a very narrow range of temperature. Details of the electrical methods of determining specific heats are easily accessible.*

The first systematic investigation of the specific heats of glasses of varying composition was carried out by Winkelmann. The method of mixtures was employed, pieces of glass of a total weight of from 100 to 250 grms. being heated in a brass wire-basket by steam to about 100°C. They were then immersed with the basket in a water calorimeter containing a thermometer and stirrer and having an initial temperature of about 14° C. The final temperature was in the neighbourhood of 18° C. The heating apparatus consisted of three co-axial vertical cylinders, the central one being fitted at both ends with sliding metal plates for opening and closing. The wire-basket, provided with a thermometer, was suspended by a silken thread and lowered half way into the central cylinder. Steam was then passed through until the temperature was sufficiently constant, the calorimeter meanwhile being placed in position beneath the heating apparatus in order to take up the temperature of its surroundings. The weight of the water was determined immediately before the experiment. The wire-basket containing the pieces of glass was then dropped into the calorimeter and stirring carried out by means of the basket itself. Observations of the rise in temperature were made at regular intervals of 20 seconds until the temperature of equilibrium was gained. A correction was added representing the lowering of the final temperature by the escape of heat during the time occupied in attaining equilibrium. This was determined from observations made before immersion combined with the fall of the final temperature. The correction added was about 0.023. Other data connected with the experiments were the following: The water-equivalent of the brass calorimeter with stirrer and thermometer was estimated to be 15-.13 grms. Two different wire-baskets were used, one weighing 24.23 grms. The water-equivalent, determined when the basket was empty, was 2.184 grms., the resulting value of the specific heat of brass being 0.09014. The difference between this value and the actual specific heat of brass, 0.093, was due to loss of heat from the basket during the interval of time in which it was being transferred to the calorimeter. It was found by careful experiment, however, that this error was allowed for by using as the water-equivalent the observed value 2.184. The weight of the second basket was 31.77 grms., its water equivalent being calculated as follows :—

$$\frac{2.184 \times 31.77}{24.23} = 2.863 .$$

The weight of the water used in the calorimeter was approximately 500 grms.

Determinations were made for 18 glasses of varying composition, the difference between different determinations for the same glass being always less than 1 per cent. The results of the determinations together with the composition of the glasses examined are shown in Table I. The figures in the first column are those found in Winkelmann's list of 72 glasses.

---

*Dict. App. Phys., Glazebrook. Vol. 1, p. 32.

Table I.

Glass No.	Composition Per Cent.										Specific Heat.
	SiO_2	B_2O_3	ZnO	PbO	MgO	Al_2O_3	BaO	Na_2O	K_2O	CaO	
3	64.4	12.0	—	—	11.0	4.5	—	8.0	—	—	0.2086
4	55.0	—	—	—	—	17.0	—	14.0	14.0	—	0.2044
5	71.0	14.0	—	—	—	5.0	—	10.0	—	—	0.2038
6	67.3	2.0	7.0	—	—	2.5	—	14.0	—	7.0	0.1988
7	73.8	—	5.0	—	—	3.5	—	10.5	—	7.	0.1958
8	67.9	—	5.8	8.1	—	1.0	—	16.8	—	—	0.1907
10	58.7	—	—	—	—	—	—	—	33.0	8.0	0.1887
12	51.3	14.0	5.0	—	—	4.5	25.0	—	—	—	0.1617
17	45.2	—	—	46.0	—	—	—	1.0	7.5	—	0.1257

Calculation of Specific Heat by Factors.

Winkelmann made the attempt to calculate the specific heat of a glass from the percentages of its constituent oxides. He used the formula

$$c = \frac{1}{100} a_1x_1 + a_2x_2 + a_3x_3 + \ldots \text{etc.},$$

where a_1, a_2, a_3, ... etc., represent the percentages of the oxides and x_1, x_2, x_3, ... etc., their specific heats.

The specific heats of certain of the oxides had already been directly determined by Regnault.* The values determined and the temperature intervals are given in Table II.

Table II.

Oxide.	Specific Heat.	Interval °C.
SiO_2	0.1913	13 — 99
ZnO	0.1248	17 — 98
PbO	0.05118	22 — 98
MgO	0.2439	24 — 100
Al_2O_3	0.2074	8 — 98
As_2O_5	0.1276	13 — 97

As no direct determinations had then been published for the other oxides, Winkelmann calculated their specific heats on the basis that one and the same chemical atom has always the same atomic heat. Neumann, Regnault, Kopp and others established the law that with compounds of similar chemical character, the products of their specific heats and molecular weights were constant. The law may be stated in the general form that the molecular heats of similarly constituted compounds in the solid state are equal. Kopp showed further that the molecular heat of a solid compound was equal to the sum of the atomic heats of its component atoms. The atoms, in combining together to form molecules, thus retain their heat capacity practically unchanged. By making use of this general principle, the specific heat of elements in the solid form have been calculated even when the elements themselves were not known to exist in the solid state. Winkelmann made use of the principle in completing his list of oxides. For example, the atomic weight of calcium is 39.9 and its specific heat between 0° and 100° is 0.1804, according to Bunsen's determinations. The atomic heat of calcium is therefore 39.9 × 0.1804 = 7.198. The atomic heat of oxygen in solid combination according to Wüllner is 4.2. Then, by the law that the molecular heat of a solid compound is equal to the sum of the atomic heats of the elements contained, the molecular heat of calcium oxide is 7.198 + 4.2 = 11.398. As the molecular weight of CaO is 55.9, then

$$\frac{11.398}{55.9} = 0.2039.$$

Hence, the value 0.2039 is deduced as the specific heat of calcium. Again, Regnault determined the specific heat of calcium chloride between the temperature 23° and 90° to be 0.1642. The molecular weight of calcium chloride, $CaCl_2$, is 110.9, and the molecular heat is therefore 110.9 × 0.1642 = 18.2098. The atomic heat of calcium is obtained by deducting the atomic heat of two chlorine atoms from that of calcium chloride, 18.2098—12.532=5.6778. The atomic heat of oxygen has already been given as 4.2. Then the molecular heat of calcium oxide is 5.6778+4.2=9.8778, and as the molecular weight is 55.9, then the specific heat is

$$\frac{9.8778}{55.9} = 0.1767$$

The mean of the two values 0.2039 and 0.1767 was adopted by Winkelmann as the specific heat of calcium oxide, that is, 0.1903.

The following values were in this manner determined for the remaining oxides from different solid combinations of the elements :—

Table III.

Oxide.	Specific Heat.
BaO	0.06728
Na_2O	0.2674
K_2O	0.1860
Li_2O	0.5497
CaO	0.1903
P_2O_5	0.1902
Mn_2O_3	0.1661
B_2O_3	0.2272

[*Continued on page* 369.

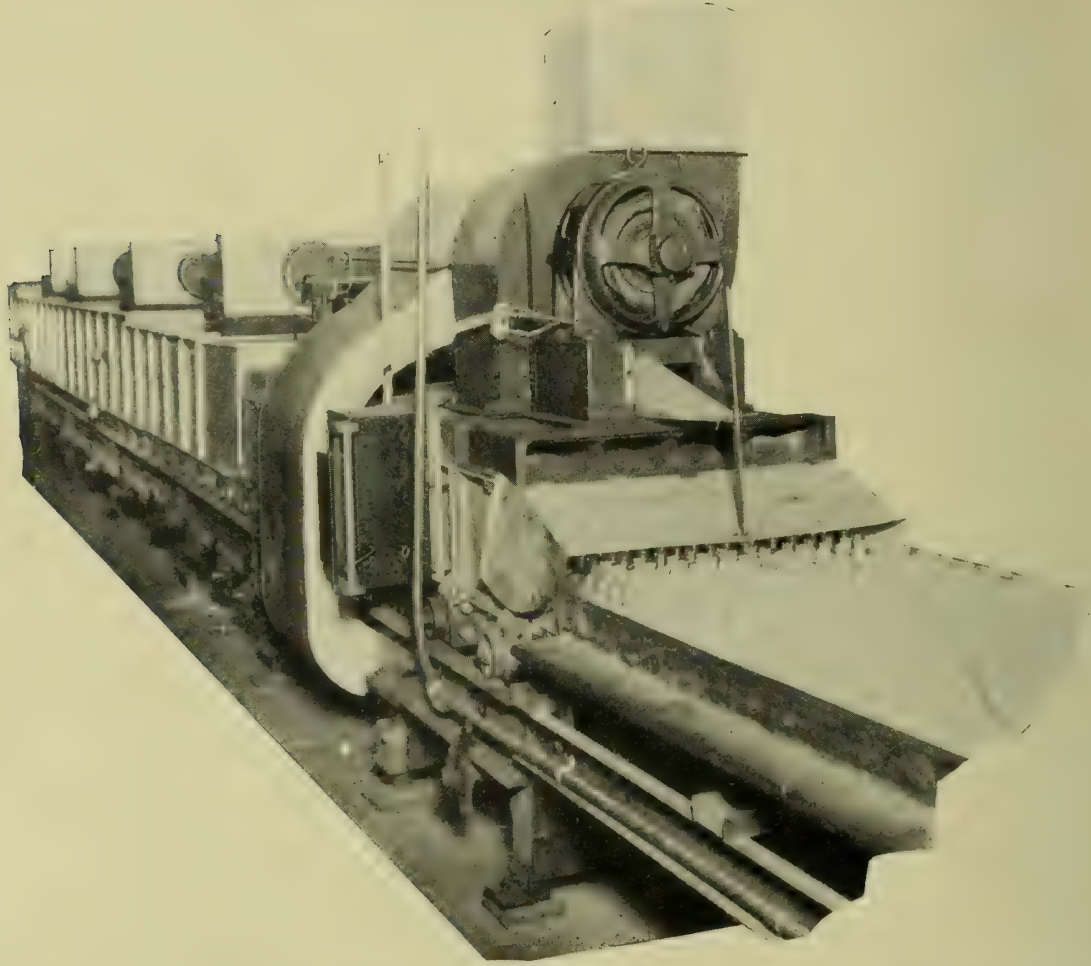
---

*Ann. de Chim. et de Phys. (3) 1, 129.

THE HARTFORD LEHR

RELIEVES Glass Manufacturers of all

ANNEALING ANXIETIES



The problem of annealing Glass Ware has always been the most difficult of the Glass Manufacturer's many difficulties.

Numerous devices have been developed to minimise annealing troubles, but no real and final solution was found until the recent invention of the HARTFORD LEHR.

The outstanding features of the HARTFORD LEHR are :—

(1) THE HARTFORD LEHR IS A SCIENTIFIC INSTRUMENT.

The Lehr is remarkable for the accuracy and precision with which the temperature conditions can be controlled. Conditions to give the desired annealing temperature curves can be accurately predetermined and reproduced at will.

(2) REGULAR AND RELIABLE FUNCTIONING.

THE HARTFORD LEHR NEVER FAILS to perform its functions of annealing. Other Lehrs "happen" to anneal **some** of the ware **sometimes**. The HARTFORD LEHR is unique in that it anneals **ALL OF THE WARE ALL THE TIME.**

(3) FUEL ECONOMY AND SIMPLICITY OF HEATING CONTROL.

Only **ONE** small burner is required.

Perhaps the most attractive feature of the HARTFORD LEHR is the astoundingly small fuel consumption. This, however, results from the fact that the lehr has been specially designed with the view of utilising to the maximum extent the initial heat resident in the ware when it leaves the Forming Machines. In one of the most up-to-date Automatic Glass Manufacturing Plants in Great Britain, a careful comparison of the HARTFORD LEHR fuel consumption over a period of ten weeks with that of modern Muffle Lehrs shows a clear direct saving of at least 65 per cent. in Fuel Costs.

(4) COMPACT AND ROBUST STRUCTURE.

Occupying merely a fraction of the space of the ordinary annealing plant, the HARTFORD LEHR is almost solely a structure of metallic parts which have been designed to permit of ease and accuracy in erection and at the same time ensure a light yet sound and substantial structure. The total absence of foundations and flues is specially noteworthy.

(5) EASE AND ECONOMY IN OPERATION.

Less labour is required, and the conditions under which the work of placing ware in the lehr is carried out constitute a vast improvement upon all other types of Lehr. There is no walking backwards and forwards between the Forming Machine and Lehr. The takers-in quickly " take to " the HARTFORD LEHR. Moreover, the sorter can handle efficiently and more comfortably, an appreciably larger quantity of ware than from the older types of Lehr.

(6) RAPIDITY OF ANNEALING.

The HARTFORD LEHR is notable for the almost amazing speed with which annealing is accomplished. As is well known, usually about four, and sometimes as long as eight hours, are considered necessary for annealing bottles on the older type Lehrs. On the HARTFORD LEHR the time taken varies from 50 minutes to 150 minutes, according to the weight of ware introduced per unit time. The advantages of this feature, particularly in permitting inspection so shortly after leaving the Forming Machine, are readily apparent.

(7) NEGLIGIBLE MAINTENANCE COST.

Although several HARTFORD LEHRS have operated continuously for periods upwards of 12 months, so far **NO** up-keep repairs have been necessary.

(8) NO LOSS OF WARE.

For the first time an annealing process is available in which there is NO ware melted, " starved," " stuck," marked, cracked, or broken in Lehring. More striking still, there is no loss of ware for poor annealing when starting up after the usual weekly shut-down.

(9) FLEXIBILITY.

Without sacrificing the precision with which the Lehr can be controlled, the dimensions and proportions have been carefully selected in order to establish the widest operating margins. It has thus been possible to produce a standard design which meets all the needs of the average Glass Manufacturing Plant. The existence of these wide operating margins, added to the unfailing regularity of control, establishes for the first time in the mind of the Manufacturer a sense of security and confidence that the ware **is being annealed AT ALL TIMES.**

For further particulars, price and delivery apply to :—

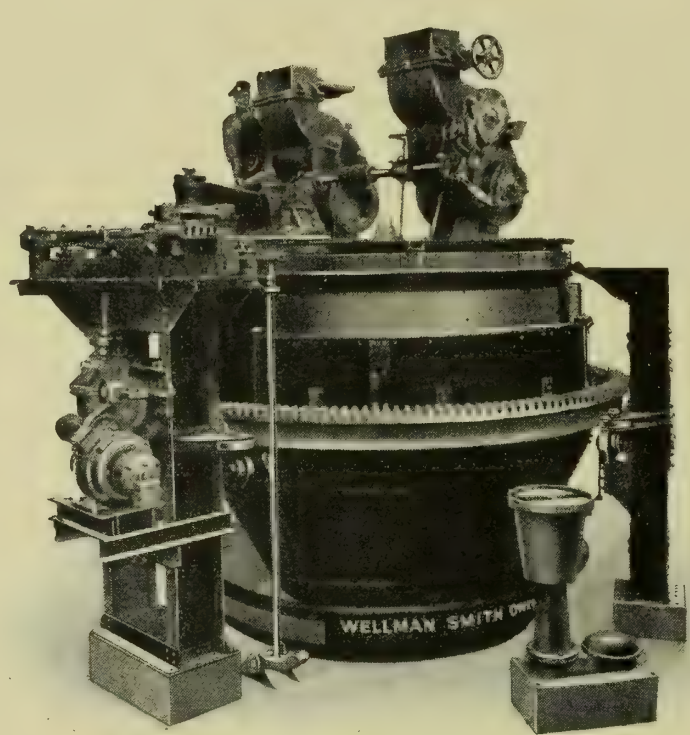
THE BRITISH HARTFORD-FAIRMONT SYNDICATE, LTD.
142-143, AUDREY HOUSE, ELY PLACE, LONDON, E.C.1.

Glass Machinery Specialists — Glass Works Engineers
"Hartford" Automatic Feeders—Forming Machines—Lehrs.

WELLMAN GAS MACHINES

INCREASE OUTPUT

BY INSTALLING WELLMAN TYPE "L" GAS PRODUCERS.



Automatic from coal feed to ash delivery.

Oscillating Poker ensures constant rich gas at all outputs.

Intermittent ash pan motion prevents clinker bridging.

Lowest labour and running cost of any producer.

The result of twenty years' continuous experience in the manufacture and running of over 1,300 Gas Producers.

Every Glassworks Manager and Engineer should send for our handbook on Gas Making.

THE WELLMAN SMITH OWEN ENG. CORP., LTD.

36-38, KINGSWAY, LONDON, W.C.2.
WORKS :: :: DARLASTON, SOUTH STAFFS.

Telephones: HOLBORN 2588 & 2589. *Telegrams:* "PRINCIPIUM, WESTCENT, LONDON."

THE SELECTION OF ELECTRIC MOTORS.

It would be extremely difficult to find any kind of machine or mechanism which gives such excellent service in return for so little attention and cost of maintenance as an electric motor which has been chosen to suit the work it has to perform and is provided with suitable control gear. This fact, coupled with the many other advantages to be obtained from electric driving has resulted in the almost universal employment of motors wherever an electric supply is available. Unfortunately it is not unusual to find that in numerous installations the type of motor best suited to the particular conditions is not being employed. This is easily understood if the many varieties that are available is considered, as well as the fact that very often the selection of the machine rests with those whose electrical training and experience is almost, if not quite, negligible.

In the following notes it is proposed to describe briefly the chief features of the principal classes of motors in the hope that they will assist in the making of the best choice to comply with specified conditions of service.

To consider the direct current machines first. These may be divided into three classes :—Shunt-wound, series-wound and compound wound. Each of these has its special features which make it more suitable for a particular drive than the other two.

From our point of view at the moment the main distinctions between them are connected with their behaviour as regards speed and starting conditions.

Shunt-wound Motors.

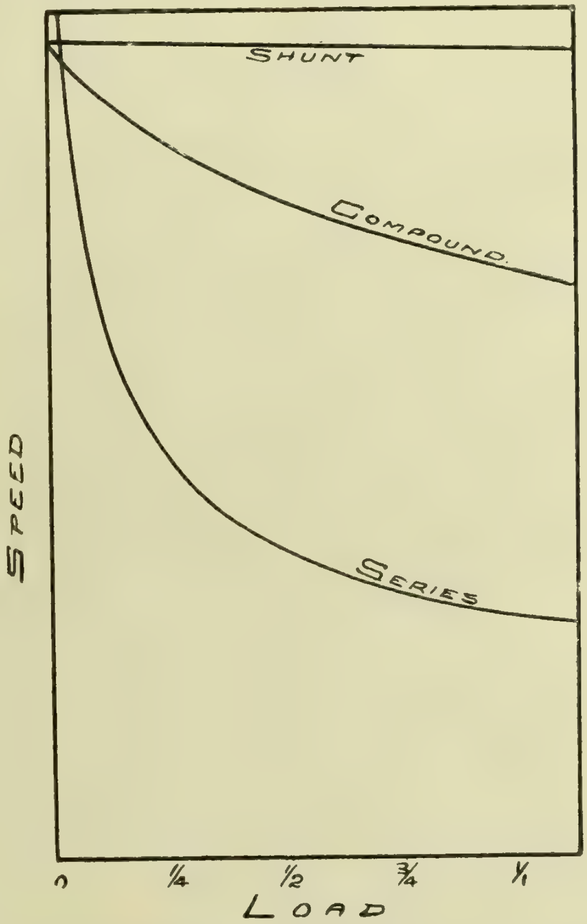
These may be described as being practically constant-speed machines in that throughout the whole range between " no load " and " full load " there is only a slight drop in speed. They are not suited, however, for starting against load (usually expressed as having a low " starting-torque "), hence it is always advisable to provide some means such as fast and loose pulleys, etc., to enable the motor to attain full speed before applying the load.

If a "field regulator" be employed, the speed may be increased to approximately 10 per cent. above the normal full load speed, and in instances where the conditions of operation are such as necessitate an exact number of revolutions per minute, a field regulator should always be installed.

Occasionally a much wider range of speed variation is necessary, such as a ratio of three or four, and sometimes six to one, between the maximum and minimum, and shunt-wound motors can be made which allow of this being obtained, though they are generally referred to as " variable speed " machines. When it is desired to maintain constant speed in spite of varying load, such as occurs in machine tool driving, etc., more particularly where the machine itself has a rotary motion such as lathes, drills, etc., the shunt-wound motor is eminently satisfactory.

Series-wound Motors.

This class have a very high " starting torque " and consequently are specially suitable for conditions which necessitate the motor starting up against full load or even over-load. As regards speed, this increases as the load decreases, so that at no-load the speed would increase indefinitely, in the same way as a steam engine without a governor. Consequently, series motors should never be employed where there is the possibility of the load being entirely thrown off, such as with pumps, compressors, etc., etc. Furthermore, a series motor should always be directly connected either by a coupling or through gearing, to the machine it has to drive, belts and ropes being absolutely prohibited.

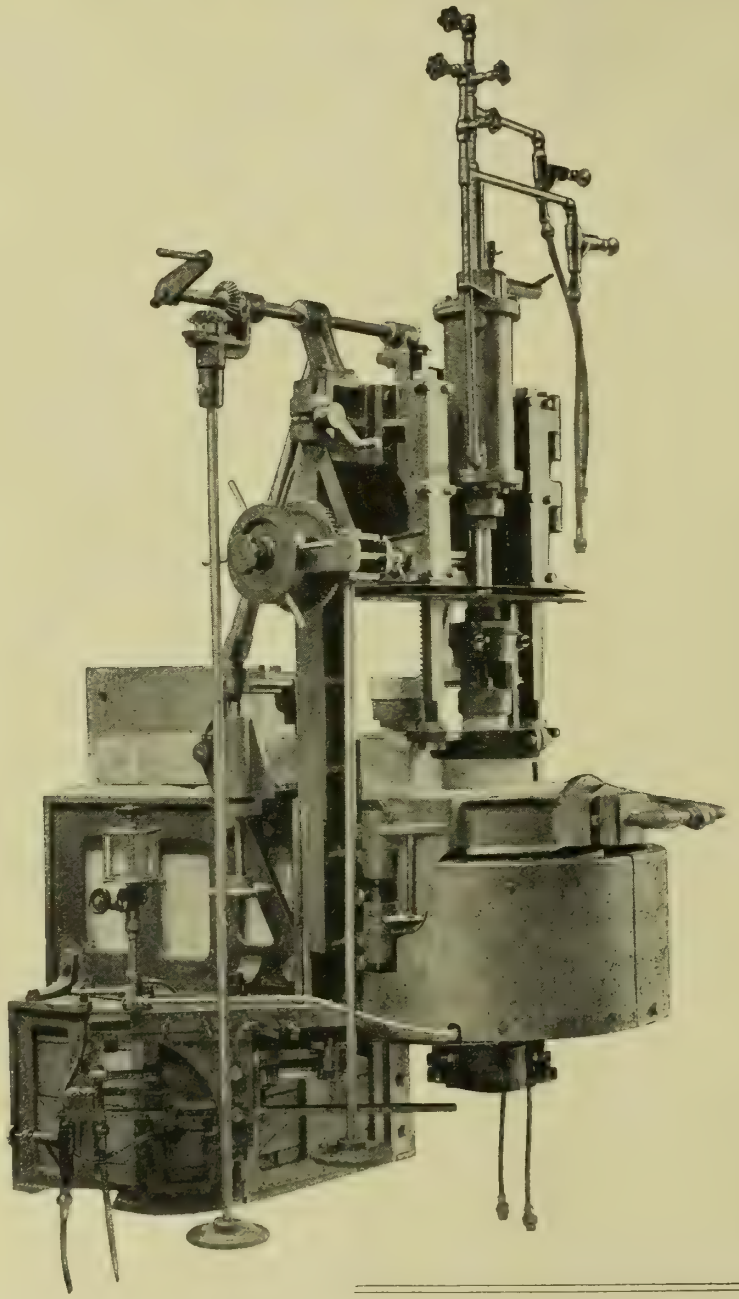


Curves showing relationships between load and speed for standard types of D.C. motors.

As the speed of a series motor adjusts itself to the load, they are usually employed for cranes, winches, etc., as they will raise a heavy load at low speeds and a light load at a high speed.

Owing to their high starting-torque they are extensively used for traction purposes such as trams, trains and electric trucks, as this feature enables them to start against heavy load and accelerate rapidly.

The "RANKIN" Automatic Glass Feeder.



RESULTS JUSTIFY CLAIMS.

Claims without justification are futile.

The need for automatic production is admitted by every glass manufacturer. The question is—what mechanism can be installed with the assurance of the best results?

The "RANKIN" record is unrivalled in the Glass Feeder world. Its history is unique. In no instance has a "RANKIN" installation once installed been superseded. On the contrary, wherever it has been adopted further installations have followed.

The latest proof of this claim is a repeat order for **TWELVE FEEDERS** from a Glass Manufacturing Company, who originally put in one Feeder for comparison with other similar devices. This we believe to be

THE LARGEST INDIVIDUAL ORDER EVER PLACED FOR AUTOMATIC FEEDERS

and represents a great triumph for an All-British Built Feeder.

The mechanism, material and finish are of the highest possible quality. The "RANKIN" Feeder is built for service and will outlast all others.

Demonstrations of the RANKIN AUTOMATIC GLASS FEEDER will be arranged by appointment.

For Illustrations, Descriptive details and terms apply to :

THE RANKIN AUTOMATIC GLASS FEEDER CO.,

1, CHARTERHOUSE STREET, LONDON, E.C.1.

Telegrams : Natiglaso, London. *Telephone Nos. :* Holborn, 140 and 141.

Compound-wound Motors.

These are a combination of the two types just dealt with. The starting-torque is greater than that of a shunt-wound and less than a series-wound machine, thus enabling them to start against normal loads. On the other hand the speed at no-load is usually higher than that at full-load, the actual amount of the drop being dependent upon the extent of the series winding used. Motors for general use are usually arranged to have a drop of about 20 per cent., but by proper adjustment of the ratio between the series and shunt windings, compound wound motors can be built to give a constant speed over the full range of load. With this type of motor the risk of attaining excessive and dangerous speeds at no-load is obviated so that they can be employed where there is a possibility of the load being suddenly thrown off. They are also particularly applicable for drives subject to sudden variations in load and severe but momentary over-loads, such as machine tools having a reciprocating motion as is the case with punching machines, etc.

(*To be continued.*)

PRACTICAL NOTES ON THE THERMAL ENDURANCE OF GLASS.

(*Continued from page 363*).

Substituting these values for x in the formula given, Winkelmann found it possible to calculate the specific heat of a given glass to within 1 per cent. error of the observed value.

The observed and calculated specific heats of the nine glasses given in Table I are compared in Table IV, the figures in the last column being the differences between the two values expressed as percentages of the observed values :—

Table IV.

Glass No.	Specific Heat.		Difference Per Cent.
	Observed.	Calculated.	
3	0.2036	0.2030	+ 0.3
4	0.2044	0.2040	+ 0.2
5	0.2038	0.2049	— 0.5
6	0.1988	0.1983	+ 0.3
7	0.1958	0.1964	— 0.3
8	0.1907	0.1888	+ 1.0
10	0.1887	0.1893	— 0.3
12	0.1617	0.1626	— 0.6
17	0.1257	0.1272	— 1.2

It is seen that much greater accuracy is gained in using factors for the calculation of the specific heat of a glass than for any of the other properties already considered. It will be recalled that the specific heat factors were either determined directly or calculated on a definite basis, i.e. that one and the same chemical atom has always the same atomic heat. The formula used in calculating the specific heat of a glass also obeys the same law. On the other hand, the factors used to calculate expansion, conductivity, etc., were obtained to a great extent empirically. It is conceivable that the explanation of the reliability of the calculated value for the specific heat of glass lies in this direction.

REFRACTORIES FOR THE GLASS INDUSTRY.

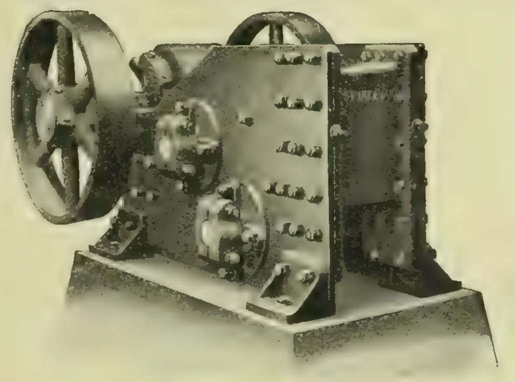
(*Continued from page 357*)

conductivity than silica bricks, typical results at 1300° C. being 0.0025 for firebrick and 0.0023 for silica brick. The thermal conductivity of a brick will obviously be affected by its porosity and permeability, so that this factor will be likely to change markedly during the life of the brick in a furnace. Green points out that a factor of greater importance than the thermal conductivity is the *diffusivity* or thermometric conductivity, which is the quotient of the thermal conductivity and the heat capacity per unit volume by the formula :

$$D = \frac{k}{CS}$$

where D is the diffusivity, C the specific heat, S the specific gravity, and k the thermal conductivity. (The diffusivity may also be considered as the rate of rise of temperature produced in a material.) As the specific gravity of a silica brick is lower than that of a fireclay brick, and their specific heats are much the same, the diffusivity of a silica brick is greater than that of a fireclay brick of the same thermal conductivity. This factor is of importance in connection with regenerator fillings. Silica bricks are better than firebricks for this purpose, not only because of their higher diffusivity, but also because their higher resistance to slagging from batch dust and their superior mechanical properties at regenerator temperatures renders the re-use possible of a much larger proportion of the bricks in a regenerator filling.

(*To be continued.*)



For Breaking down Glass Cullet

the Sturtevant Roll Jaw Fine Crusher is the ideal machine. It can be adjusted to give a coarse or fine product, and the mechanism ensures smooth running, slow speed, and the minimum of power.

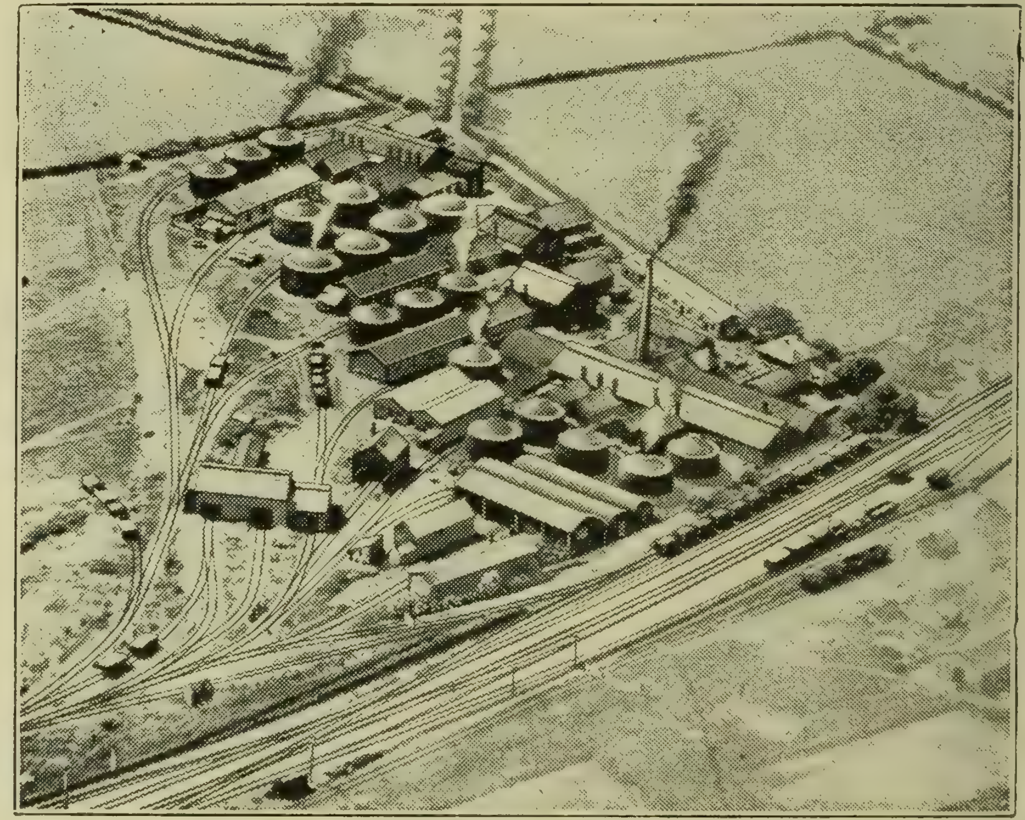
Write for free leaflet G.L. 1541.

STURTEVANT ENGINEERING Co. LTD.
149 QUEEN VICTORIA ST LONDON E.C.4.

THE MOST DURABLE **BRICK**
MADE FOR **GLASS FURNACES.**

STEPHENS SILICA "C"

EXTREMELY REFRACTORY, TOUGH AND DURABLE.



VIEW TAKEN FROM AN AEROPLANE.

Kiln Capacity 1½ Million Bricks. Works Cover over 9 Acres.

SUPER SILICA CEMENT for setting SILICA BRICK.

Used by most of the principal GLASS WORKS.

STEPHENS & CO., KIDWELLY.

The Use of Compressed Air—*Continued.*

By ROBERT WILSON.

Power Required to Drive Air Compressors.

The survey of the compressor work cycle, as given in the preceding article, shows, in general, that the lower the compression ratio the poorer is likely to be the actual process of compression, and the greater the percentage of extra work due to excess pressure. The survey shows also that while the work of re-expansion increases as the clearance ratio, or the compression ratio, increase, the effect on the work required to deliver a given capacity is practically neutralised by the reduction in volumetric efficiency which automatically follows an increase in the work of re-expansion. The summary, therefore, of the survey is that the losses of compression tend to increase as the compression ratio decreases.

From the diagrams in Fig. 9 it is possible to obtain some idea of the effect of the losses of compression on the work of the compressor cycle, and, also, the range of delivery pressures for which it is necessary to make allowance for these losses in calculations for the work required to compress and deliver a given volume of free air. These diagrams are intended to show approximately the conditions which are probable in practice for delivery pressures of 20, 40 and 80 lb. per sq. in. gauge, and also the relation of the practical conditions to the lines of the theoretical diagrams. The isothermal and adiabatic compression lines are shown on each of the diagrams, and the areas shaded are those which lie beyond—although not necessarily additional to the area of—the theoretical adiabatic diagram, on which are based the calculations for the table of power constants to which reference has already been made. The three diagrams are to the same scale, and, since no considerable error is incurred, the amount of the excess pressure has been made the same for all three, in order that a better comprehension may be had of the proportion of the shaded areas to the theoretical adiabatic diagram, and also the pressures at which these shaded areas cease to be additional to the area of the theoretical adiabatic diagram.

It is obvious from the diagrams that the area lying beyond the lines of the theoretical adiabatic diagram is a greater proportion of the whole for the lowest than for the highest pressures, and, also, that at the lowest pressure the area of the actual diagram is greater than the area of the theoretical adiabatic diagram. As the compression ratio increases the area lying beyond the adiabatic becomes a smaller proportion of the whole, until it is off-set by the saving effected in the compression process.

Since it is obvious that for certain pressures the work done on the air is greater than would result from calculation on the purely adiabatic basis, it follows that an allowance must be made to cover for the extra work. The most simple way to cover for this extra work is by manipulation of the table of power constants, since it would be inconvenient to make elaborate calculations every time it was required to know the work necessary to compress and deliver a given volume of free air to a comparatively low pressure. Some assistance in this respect can be obtained from the diagrams in Fig. 9, the position of the compression line of the actual diagram in relation to the line of adiabatic compression, together with the proportion of the shaded areas in respect to the areas of the actual diagram and the adiabatic diagram, enabling a new value to be calculated which would provide approximately for the extra work which must be allowed for at certain pressures.

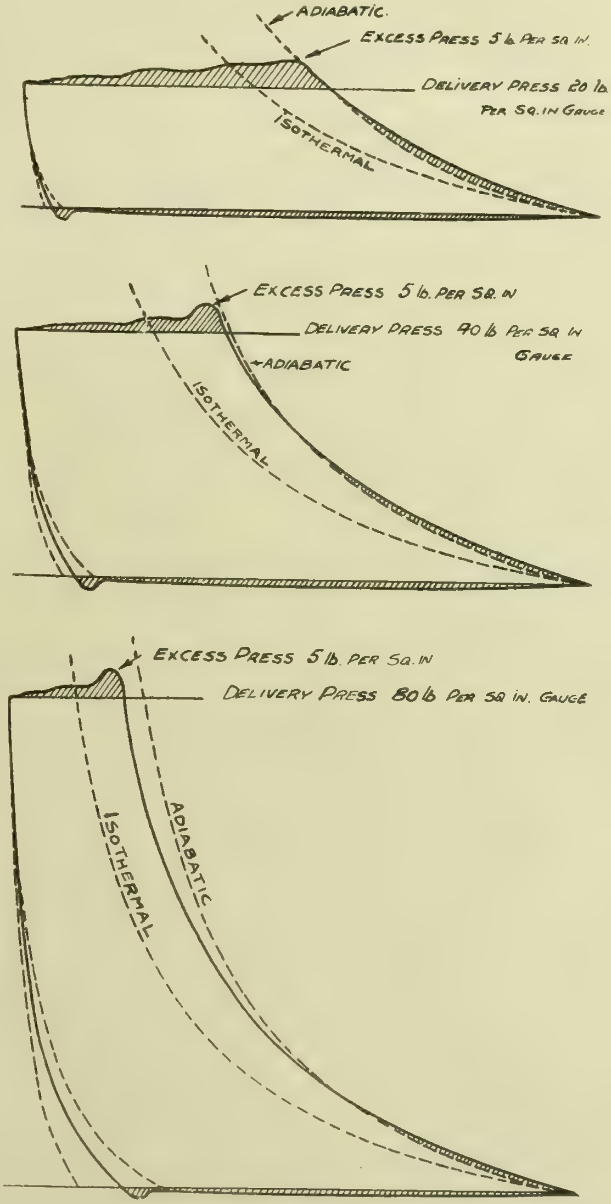

ADIABATIC.
EXCESS PRESS 5 lb PER SQ IN.
DELIVERY PRESS 20 lb PER SQ. IN GAUGE
ISOTHERMAL
EXCESS PRESS 5 lb. PER SQ. IN
DELIVERY PRESS 40 lb PER SQ IN GAUGE
ADIABATIC
ISOTHERMAL
EXCESS PRESS 5 lb. PER SQ. IN
DELIVERY PRESS 80 lb PER SQ IN. GAUGE
ISOTHERMAL
ADIABATIC

Fig. 9.

PARKINSON & SPENCER, Ltd.

Ambler Thorn Fireclay Works,
HALIFAX, YORKSHIRE.

ESTABLISHED
1800.

Telephone : No. 1207.
Telegrams : Parkinson & Spencer, 1207 Halifax

Manufacturers of Refractory Goods of every description for the Glass industry, viz :

GLASS-HOUSE POT CLAY, FIRE CLAY, FIREBRICKS, TANK BLOCKS, BINDERS, etc.

Our Tank Blocks are unsurpassed for quality and durability.

WE SPECIALIZE IN BEST POT CLAY MATERIAL.

New Plant recently erected for the cutting and dressing of Tank Blocks to any dimensions.

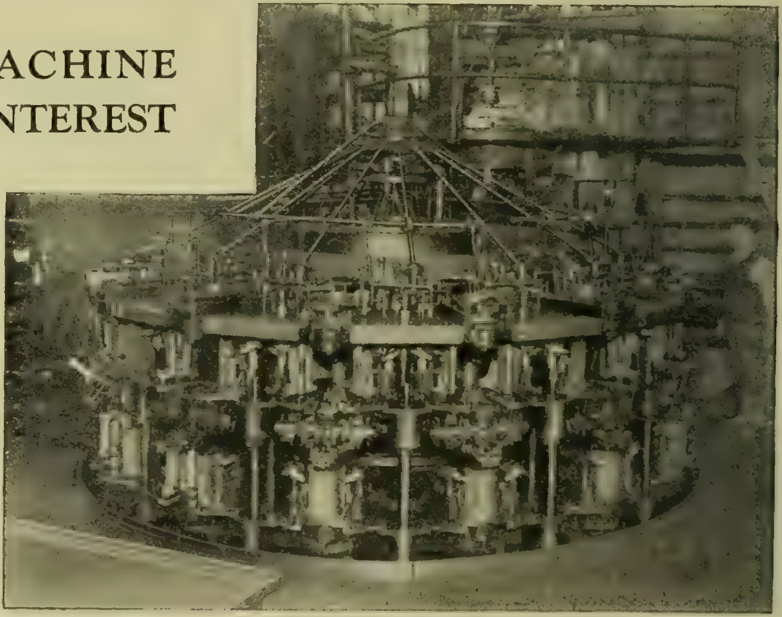
FAVOUR US WITH YOUR ORDERS AND YOU WILL BE SATISFIED WITH RESULTS.

NEW GRAHAM MACHINE CREATING GREAT INTEREST

Offers unusual advantages because of improved construction. Eliminates intermittent rotation which causes wear and tear through jerking. Continuous rotation permits larger production and lower operating costs.

Flexibility of operation appreciated. Produces both narrow and wide mouth bottles in wide range of sizes. Makes push-up bottoms without separate operation.

Three sizes of same construction.
AZ Machine, 15 blank and 15 blow molds
AY Machine, 10 blank and 10 blow molds
AY6 Machine, 6 blank and 6 blow molds
Molds and mold operating parts are interchangeable.



AZ Flow Type—Maximum Speed 72 Bottles per Minute

THE OWENS BOTTLE COMPANY—TOLEDO, OHIO, U. S. A.

Ask us for illustrated catalog, giving complete information.

Table III gives the figures for indicated horse power and brake horse power required to compress and deliver one cubic foot of free air per minute to different gauge pressures by single-stage compression. Column 3 gives the I.H.P. for isothermal compression, column 4 the I.H.P. for adiabatic compression, and column 5 the approximate I.H.P. required in the compressor cylinder after allowing for the losses of actual compression.

Table III

Showing the Indicated Horse Power required (theoretically and actually) to compress and deliver One Cubic Foot of free air per minute by Single-Stage Compression. Also the Brake Horse Power required at the Compressor Flywheel for same capacity.

Gauge Pressure lb. (1)	Compression Ratio. (2)	Theoretical I.H.P. (Initial Temp. of Air 60° Fah). Isothermal Compression. (3)	Theoretical I.H.P. (Initial Temp. of Air 60° Fah). Adiabatic Compression. (4)	Actual I.H.P. Approx. (5)	Mechanical Efficiency. (6)	Brake Horse Power required at Compressor Flywheel. (7)
10	1.68	.033	.036	.054	.750	.072
15	1.95	.045	.050	.064	.780	.082
20	2.36	.055	.062	.074	.800	.092
25	2.71	.063	.074	.084	.825	.108
30	3.04	.071	.084	.094	.825	.114
35	3.38	.078	.094	.103	.835	.123
40	3.72	.084	.103	.111	.850	.131
45	4.06	.089	.111	.116	.850	.136
50	4.40	.095	.119	.124	.850	.146
55	4.74	.099	.127	.130	.850	.152
60	5.08	.104	.134	.135	.850	.160
65	5.42	.108	.140	.142	.850	.167
70	5.76	.112	.147	.148	.860	.173
75	6.10	.116	.153	.153	.860	.178
80	6.44	.119	.159	.159	.865	.184

Column 6 gives the values for mechanical efficiency, these values being based on the assumption that the compressor would be of moderate capacity and that for any particular pressure the compressor used would be of a type reasonably well suited for the duty. Column 7 gives the B.H.P. required at the compressor flywheel.

Mechanical Efficiency.

The explanation of the basis on which the figures in column 6 are based is that the mechanical efficiency of modern forced lubricated air compressors is practically constant at a given speed for all conditions of load, and, generally, depends more on the weight of the moving parts than on frictional resistance.

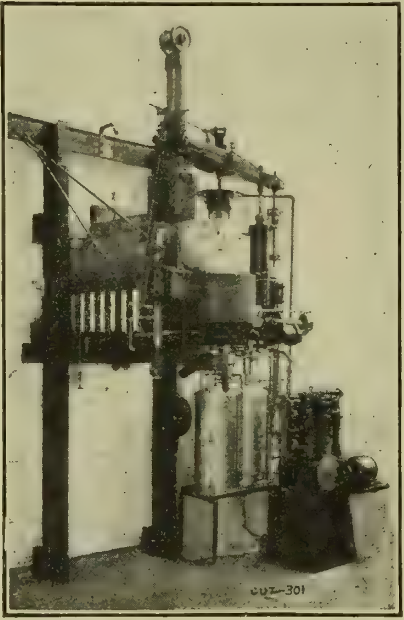
The amount of friction depends on the effectiveness of the lubrication, and as the working bearings of most types of modern air compressors are lubricated by oil fed under pressure by means of a pump, which maintains a film of oil between bearings and journals, even at full load, and so practically eliminates metallic contact, the friction in the bearings is almost negligible. The effectiveness of the lubrication in the cylinder depends largely on the extent of the temperature range due to compression. Frictional resistance to the movement of the piston in the cylinder tends to become greater as the compression ratio increases, and where the temperature due to compression rises above the temperature at which effective lubrication can be obtained, the ensuing dry surface of the cylinder means not only increased friction with low mechanical efficiency, but also a higher temperature of the air being compressed, since the friction of the piston and piston rings generates heat, some of which passes into the air. With low compression ratios ineffective cylinder lubrication should be a remote possibility, but if excessive piston friction occur in a low pressure machine the adverse effect would be greater and more noticeable than if the same thing occurred in a high pressure machine and would make for a greater reduction in the efficiency of the compression process.

Since the greater portion of the work converted into mechanical energy is utilised in overcoming the inertia of the moving parts, and as the inertia is constant at a given speed, it follows that the mechanical efficiency of any compressor will be highest when the compressor is working at the maximum load for which it was designed. If the machine is operating at a lower load the mechanical efficiency will automatically drop. Thus, a compressor designed for a duty of say 100 lb. pressure per square inch would not be so efficient when working to a pressure of say 20 lb. per square inch as would be a machine specially designed for the lower pressure, since in the latter the weight of the working parts should be much less. It is apparent, therefore, that the lighter the weight of the working parts the higher the mechanical

[*Continued on page* 385.

MODEL KFO.

LATEST MILLER FEEDER



PROGRESSIVELY
DEVELOPED
SINCE 1907.

WILLIAM J. MILLER, INC.
SWISSVALE, PA., U.S.A.
London Office: 366 STRAND, LONDON, W.C.2 Tel. No.: REGENT, 5647.
Cable Address AUTOGLASMA, RAND, LONDON & AUTOGLASMA, PITTSBURG, PA

THE LONDON LEAD OXIDE Co., Ltd.

Offices : 107, Bishopsgate, LONDON, E.C.2
Telephone No. : London Wall 4527.
Tele. Address : "Londoxid, Ave, London."

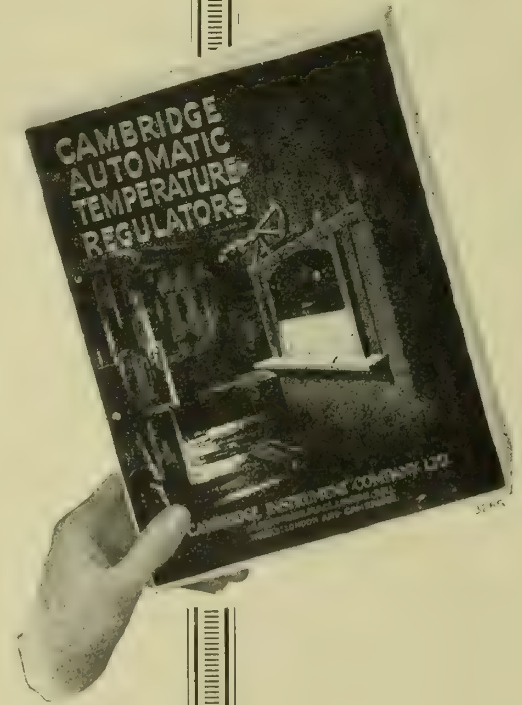
Works : Royal Pier Rd., GRAVESEND, Kent.
Telephone No : Gravesend 112.

MANUFACTURERS OF

GENUINE **ENGLISH** REFINED

GLASSMAKERS' RED LEAD

Buyers who wish to obtain the very best material at the lowest price should write for samples and particulars.


CAMBRIDGE AUTOMATIC TEMPERATURE REGULATORS
CAMBRIDGE INSTRUMENT COMPANY LTD.

THIS NEW BOOK

NO. 150-V

contains useful information regarding the automatic regulation of temperature, and describes apparatus which can be used to control the temperature of practically any type of annealing furnace. We shall be pleased to forward a copy free at your request.

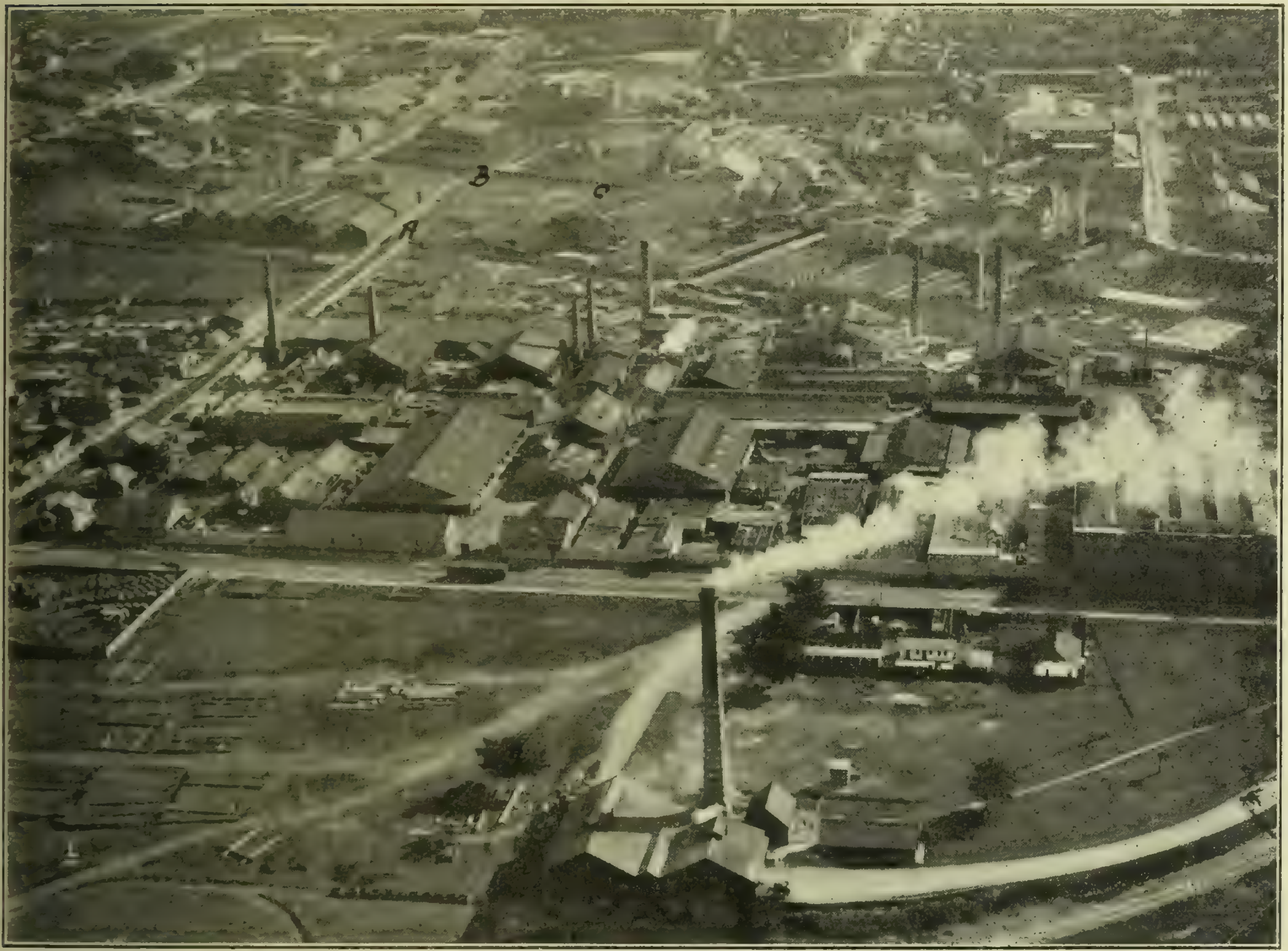
CAMBRIDGE INSTRUMENT Co. LTD.

WORKS :-
LONDON &
CAMBRIDGE

Head Office & Showrooms :- 45, GROSVENOR PLACE
LONDON, S.W.1.

17

AN AUSTRALIAN GLASS WORKS.



Through the courtesy of the Australian Glass Manufacturers Co., Ltd., we are able to publish this aerial photograph of a portion of one of their factories in Sydney, N.S.W. The area covered by the factory is twenty-one acres.

For the year ended March 31st the company made a profit of £163,799, this being an increase of £12,589 over the results for the previous year. The dividend for the year was 10 per cent. on the ordinary and 9 per cent. on the preference shares.

* * *

The continuous and insistent call for refractories better able to stand up to the requirements of modern processes and conditions is not confined to the glass industry alone, and has led to the introduction of numerous so-called "super-refractories."

As, however, many of these have been developed with the object of obtaining improvement in some one specific direction, often at the expense of other qualities which are not of such great importance for the particular duty involved, it is becoming necessary to pay particular attention to the qualities *not* claimed.

U.S. TARIFF ON PLATE GLASS.

Quite recently we mentioned that representatives of the U.S. Tariff Commission were endeavouring to obtain data as to the costs of producing plate glass in this country and also in Belgium and the Continental countries, the information being required in connection with an application for increased duties on imported plate. Now, representatives of the American motor car industry have also presented an appeal in support of this increased duty, stating that the "continuous" process used in England and Belgium enables European glass to be landed at American works 6 cents per foot cheaper than the American factories can produce it. It is of interest to note that many of the plate works in America are controlled by the motor car interests, whilst the "continuous" process is, of course, also being operated in America.

It is expected that the Tariff Commission will be in a position to decide what is to be done by the end of this year.

TELEGRAMS:
"GLASMACHIN, ESTRAND, LONDON.
CABLES:
"GLASMACHIN, LONDON"
CODE:
BENTLEY'S.
TELEPHONE:
CENTRAL 5985.

C. SAXTON, A.M.I.E.E., M. IRON AND STEEL INST., Etc.

CONSULTING ENGINEER

Talbot House,
Arundel Street,
Strand, London, W.C.2.

BOTTLE MOULDS

ORDER YOUR MOULDS FROM

E. LUNN & Co., MOUNT STREET, GLASGOW.

Largest MAKERS of MOULDS in the UNITED KINGDOM

Quick Deliveries and Complete Satisfaction Guaranteed.

MOULDS FOR ALL TYPES OF MACHINES SUPPLIED

ALL MOULDS MADE OF CHILLED CASTINGS ONLY.

Telephone—
WESTERN 2792.

Telegrams—
GLASMOLD, GLASGOW.

ONE OF OUR RECENT TESTIMONIALS—

"We have one set of Ordinary Round Quart Moulds which you supplied to us which have been working for 2½ years. These are still in perfect condition, showing no cracks or any other flaw in the metal. They have been working almost continuously for the above period, only being off the machines for a week or two at a time. We have also other moulds in Square, Oval and special shapes which have been working quite as long as the Ordinary Round Quarts, although not so continuously, and these also are in perfect condition. We have always found your moulds more satisfactory than any others, and the metal you use is much more durable than any supplied by other firms."

Reference on our Testimonial File: A.B. 91.

Trade "TWENTY MULE TEAM" Mark

Granulated

BORAX

Specially refined for
ENAMELLERS
AND POTTERS

BRITISH MANUFACTURE.
Guaranteed 99·50% pure.

Entirely free
from phosphates.

BORAX CONSOLIDATED LTD,
16, Eastcheap, LONDON, E.C.3.

TRADE NOTES.

The Federation of British Industries are to be congratulated upon the final success of their efforts on behalf of British firms, as in connection with the French Debt Settlement the French Government undertakes to compensate, on approximately the same basis as French businesses are being compensated, those British businesses located in France which suffered damage during the War.

The claims are estimated to amount to six and a half million pounds sterling, and the F.B.I. has been actively urging the necessity for equality of treatment in this matter.

◆ ◆ ◆

From Mr. L. Milner Butterworth, F.R.C.S., we have received a reprint of a paper entitled "Old English Drinking Glasses and Their Makers," which he read before the Lancashire and Cheshire Antiquarian Society.

◆ ◆ ◆

Messrs. Ernest Benn, Ltd., have sent us an advance prospectus of a new book on "European Glass," by Wilfred Buckley, C.B.E. The book will contain a Foreword by Bernard Rackham, of the Victoria and Albert Museum, and an Essay on "Dutch Glass Engravers" by Dr. Ferrand Hudig, of the Nederlandsch Museum. The volume will be ready in the autumn this year.

◆ ◆ ◆

To mark the completion of forty years' practice in the profession of a Registered Patent Agent, Mr. B. J. King, Managing Director of King's Patent Agency, Ltd., has re-issued his well-known handbook, *Patents for Inventions,* in a new and more complete form. The book contains a host of valuable information, not only on the subject of patents, but also on trademarks and designs, and will be of especial interest to those who having evolved or developed an idea, are a little perplexed as to the procedure necessary to protect it.

◆ ◆ ◆

Messrs. Sutax, Ltd., inform us that they are making a special point of standardising all sizes of glass finishes suitable for their closures, as they believe that this will not only mean better service to their customers but will also prevent misunderstanding and trouble for glass manufacturers supplying glassware for use with the closures.

◆ ◆ ◆

According to a D.O.T. report just published the exports of glassware from Roumania during the year 1925 amounted to 1,175 metric tons, with a value of approximately £25,900. For 1923 and 1924, the figures were 43 tons, valued at £1,790, and 300 tons, valued at £6,300. The imports of glassware for 1925 amounted to 8,697 metric tons, valued at £442,400, the corresponding figures for 1923 and 1924 being respectively 13,661 tons, valued at £318,200, and 9,906 tons, with a value of £213,780.

◆ ◆ ◆

A D.O.T. Report on the commercial situation in Hungary states that the small glass industry was fully employed during 1925, but no new establishments were opened. A few bottles were exported but, in general, glass and glassware was imported.

During 1925 the quantity of glass imported amounted to 16,729 tons, valued at 10 million gold korona; during 1924 the figures were 12,732 tons, valued at 6¼ million gold korona.

◆ ◆ ◆

The Rankin Automatic Glass Feeder Company, Limited, has been formed as a private limited company, with a registered capital of £15,000 in £1 shares. The first directors are C. J. P. Pratt (Chairman so long as he holds 2,000 shares) and C. H. Rankin.

◆ ◆ ◆

GLASS MANUFACTURERS' FEDERATION.

For over a year past a movement has been on foot to form a national Federation of Manufacturers in the Glass Industry. At a meeting held on March 30th, to which all manufacturers of glass bottles and containers in the country were invited, a Provisional Committee was appointed to work out a scheme for the organisation of such Federation in detail.

During the summer this Committee held four meetings, and on the 27th July last presented its report to a further General Meeting of Glass Bottle and Container Manufacturers.

As a result of these two meetings, a Glass Manufacturers' Federation has been formed, with Sir Sydney Henn, M.P., as first Chairman, and Mr. S. B. Bagley as first Vice-Chairman. Mr. Geoffrey Marchand has been appointed Director of the Federation, the offices of which are at 40-43, Norfolk Street, Strand, W.C.2. (Telephone: Central 3033.)

◆ ◆ ◆

With reference to the note on the "Kango" electromechanical hammers which appeared on page 340 of our July issue, the address of the Company was wrongly given. The correct address is 78, Petty France, Westminster, S.W.1.

◆ ◆ ◆

The report of Forster's Glass Company, Ltd., for the year ended March 31st last, shows a gross trading profit of £43,323, which after providing for debenture, bank interest and directors' fees, leaves a net credit of £29,432, with £6,636 balance brought forward. £5,000 has been written off plant and machinery, £5,000 off patents, £6,500 off loose plant and tools, and £10,000 transferred to the reserve account, leaving a balance of £9,568 carried forward. Owing to the coal strike and general industrial situation the directors are unable to recommend a dividend or to put forward any proposals to deal with the arrears on Preference shares as they had hoped to do.

◆ ◆ ◆

On June 27th and 28th last, the well known Belgian glass company, Cristalleries de Val St. Lambert, celebrated its centenary. Prince Leopold of Belgium attended the festivities and conferred decorations upon some of the officials, including M. Leerenier, Engineer, and M. Fraepont, the General Manager.

During the course of the proceedings it was stated that in 1826 the company had 100 employees, but that at the present time there are over 4,000. As instances of long service there are 628 with over 25 years, 502 with more than 35 years, and 170 with more than 50 years' continuous service with the company.

Many Glass Manufacturers
have PROVED the

MANSFIELD
CRUSHERS and
GRANULATORS
to be the BEST for

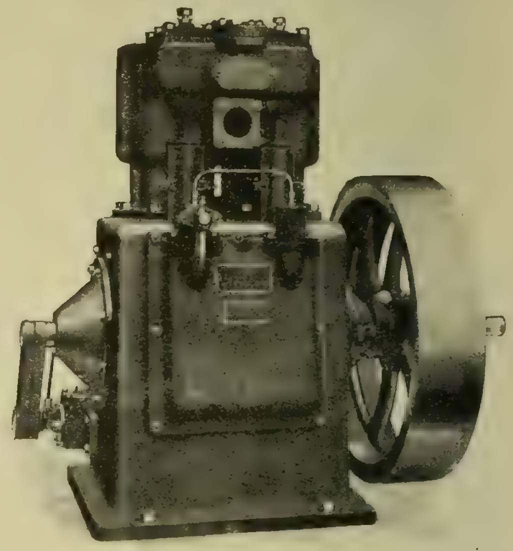
dealing with Manganese Ore, Limestone, Saltcake, Cullett, etc., etc.

Materials always remain GRANULAR irrespective of size.

FRANK MANSFIELD & CO.,
9, REDCROSS ST., LIVERPOOL.

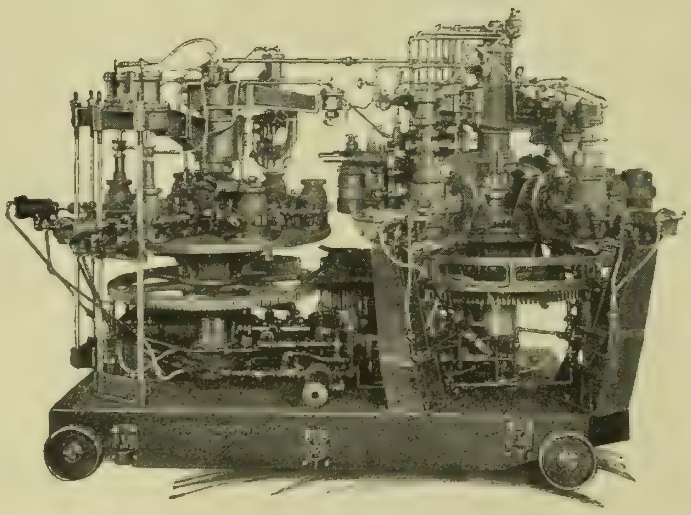
Telegrams: PRECEDENCE, LIVERPOOL.
Telephone: 4925 BANK.

"BROOMWADE"



AIR COMPRESSORS
BRITISH AND BEST
FOR ALL DUTIES.

BROOM & WADE, Ltd., HIGH WYCOMBE



The New O'Neill No. 44
Blowing Machine.

A well-built, high speed blowing machine with a range from 6 oz. to 40 oz. in capacity. Operating speeds up to 23 per minute depending on the class of ware being made. Have our London representative give you the details.

THE O'NEILL MACHINE CO.,
TOLEDO, OHIO, U.S.A.

LONDON OFFICE: 10 SAVOY ST., STRAND, LONDON, W.C.2.

Telephone: Gerrard 7190.
Telegrams and Cables: Oneillany, Rand, London.

The "How and Why" of Pyrometer Resistance.

A clear explanation, showing how robust, yet accurate, pyrometers of low resistance may be applied in many places in glass works.

In past days, few practical glass technologists troubled themselves with the principles of construction of electrical pyrometers; they left such matters to the few experts, including the pyrometer makers. But in present times realisation of the vital importance of temperature regulation in glass manufacture has resulted in a wider desire to know something of how electrical pyrometers operate, and why certain elements in their design are considered of primary importance. One such element, which has lately come into special prominence, is the question of the electrical resistance of the indicator or recorder. It is therefore believed that some explanation of the effects of high or low resistance in the indicator recorder will be of general interest to all those whose duties involve the use of pyrometers in glass works, and may also be of assistance to those already having some knowledge of the matter, because the more fully the principles are understood the less is the danger of that little knowledge which is so often a dangerous thing. It may be fairly said now that the developments in the use of pyrometers have advanced so far that the technical user should be in a position to choose the instruments for a glass works with some knowledge of the elements in design that affect their performance, and should no longer be content to be guided, more or less blindly, by the pronouncements of writers who give advice on pyrometry without stating their arguments fully. Even with careful condensation it has been found impossible to present the salient facts in a few paragraphs but, since the conclusions may lead to extensive savings in first cost and repair of pyrometers and also may point the way to applying those instruments where hitherto the conditions have been considered or found to be unfavourable, study of the factors and conclusions therefrom will probably repay every reader having any part in the control of glass manufacture. It will also be seen that the conclusions apply with equal force to other industrial uses of pyrometers.

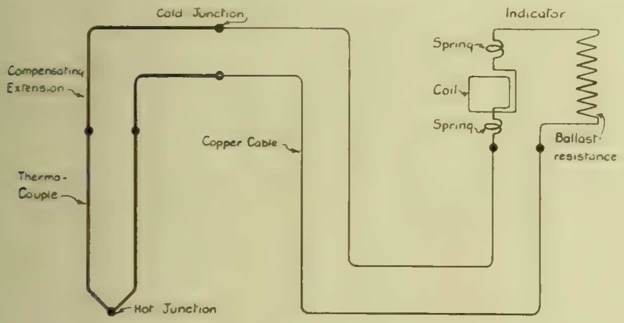


Fig. 1.
Diagram of Thermo-couple Pyrometer Circuit.

The following notes are specially directed to the thermo-electric (or thermo-couple) type of pyrometer, which is most commonly employed in glass works pyrometry. It may be mentioned that this type will include also the radiation pyrometers in which usually the sensitive part is actually a very small thermo-couple. As the matters discussed apply equally to indicators and recorders, the former term is to be understood as including also the latter.

An elementary thermo-couple pyrometer is shown in the diagram Fig. 1, and will be seen to comprise the thermo-couple whose hot junction is submitted to the temperature, possibly also a compensating extension, the cold junction, or comparison point, where the thermocouple wires join the copper cable, and an indicator in which are a moving coil, two springs and a ballast resistance whose functions will be referred to later. The fact that the hot junction is at a higher temperature than the cold junction generates a small E.M.F. (voltage or electrical pressure), thus causing a current to flow in the circuit and through the moving coil in the indicator. The E.M.F. available is very much smaller than even that from a single dry cell; actually of the order of one-hundredth part, or, to give another comparison, only about one-tenthousandth of the voltage of an ordinary lighting circuit. As is well known, the lower the electrical pressure the smaller the resulting current, so that, in actual practice, the currents are seldom as large as one-tenthousandth of the current in an ordinary electric incandescent lamp. Herein lie the roots of many of the problems of electrical pyrometry.

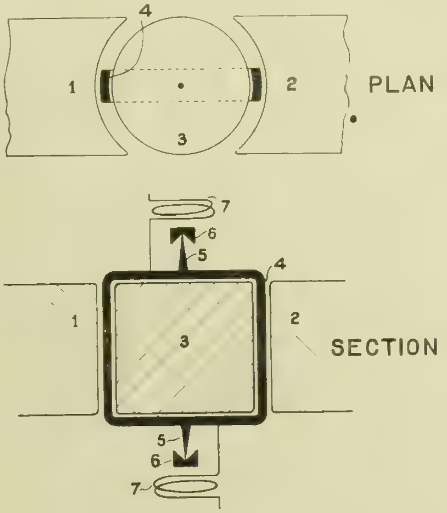
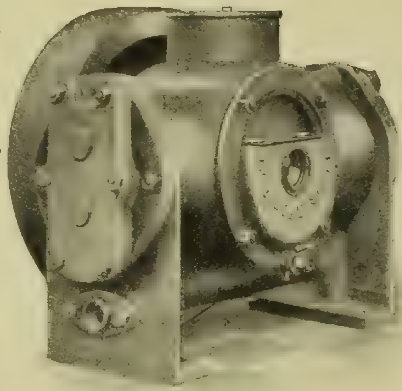


Fig. 2.
Diagram of Indicator Movement.

It is necessary now to consider briefly the construction of the indicator. Fig. 2 shows this diagramatically. A magnetic field is generated by a permanent magnet (not shown) having pole pieces 1 and 2, and a cylindrical core 3. The annular "air-gap" between the pole pieces and the core is crossed by a strong "magnetic field." In this air gap a moving coil 4 swings and is carried by finely pointed pivots 5,5 bearing in conical jewels 6,6. The current is led into and away from the coil by the springs 7,7. The construction is similar to an ordinary

AIR COMPRESSORS
& VACUUM PUMPS



As Illustrated
in 5 sizes
from
10 to 80
cubic feet per
minute

Other types
Larger sizes

Any Pressure
or Vacuum

LACY-HULBERT & CO., LTD.

BOREAS WORKS, BEDDINGTON
NR. CROYDON, SURREY
Telephone: CROYDON 1698.

Moulds

Machined to specification from finest crucible chilled castings by highly skilled craftsmen; our works equipment ensures accuracy and superiority of finish.

SPECIALITIES—

Mould equipment for **Lynch, Miller, O'Neill** and other Automatic Machines.
Glassworks Patterns, Crucible Iron Castings.

ALL ORDERS EXECUTED PROMPTLY.

Johnson Radley & Sons, Ltd.,
Chesney Works, Hunslet, LEEDS.

Telegrams—MOULDS, LEEDS. Telephone—LEEDS 21354.

TECHNICAL BOOKS.

The following are of special interest :—

A TEXTBOOK OF GLASS TECHNOLOGY.
Hodkin & Cousen. 551 pp. 251 Illustrations.
42/- net.

MODERN GAS PRODUCERS.
N. E. Rambush. 545 pp. 356 Illustrations.
55/- net.

THE FLOW OF GASES IN FURNACES.
Groume-Grjimailo. 397 pp., including Appendix on Furnace Design.
27/6 net.

OIL FUEL.
Its Supply, Composition and Application.
E. Butler. 4th Edition. 310 pp. 158 Illustrations.
12/6 net.

INDUSTRIAL FURNACES.
W. E. Trinks. Vol. I. 2nd Edition.
22/6 net.
Vol. II. 405 pp. 292 Illustrations.
27/6 net.

THE DECIMAL PLATE AND SHEET GLASS CALCULATOR.
Samuel S. Lindsay,
Comptroller of the Pittsburgh Plate Glass Company.
29/6 net.

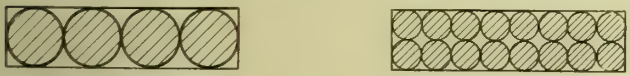
One large glass company estimate they are saving £600 a year in one department by the use of this book.

ANY Technical Book can be obtained from—

GLASS PUBLICATIONS, LTD.,
Talbot House Arundel Street,
Strand, LONDON, W.C.2.
Telephone : Central 5985.

ammeter and is essentially like an electric motor in which the armature (consisting of a system of coils) turns in a magnetic field when current is passed through it, so the moving coil 4 tends to turn about its axis under the influence of the current from the thermo-couple, but its turning is limited by the resistance of the control springs 7,7; thus the amount of turning (or torque) of the springs is a measure of the current flowing. By attaching a pointer to the coil and providing a scale, or attaching a pen arm marking on a chart, an indication or record is provided showing the actual temperature measurement.

The turning force, or torque, generated by the reaction between the magnetic field and the coil depends upon the strength of the magnetic field, the current flowing in the coil, and the number of times the current passes round the coil (ampere-turns). For instance, with any given magnetic field, a current of one ampere passing four times round the coil would generate the same torque as a current of one-quarter of an ampere passing sixteen times round the coil; in each case there would be four ampere-turns. The diagram in Fig. 3 shows how these two coils would each have the same total cross section, and would therefore be the same weight. Many factors, in addition to considerations of weight, size and cost, put fairly definite limits upon the strength of the magnetic field and somewhat similarly the maximum allowable crushing stresses on the fine pivot points out limits to the size and weight of the moving coil so that, in practice, these factors are more or less fixed and uniform in different designs of indicators; consequently there remains as a possible variable the size of the wire used, and therefore the number of turns in the coil; if finer wire is used there will be more turns.


Thick wire, few turns, Low Resistance.

Thin wire, many turns, High Resistance

Fig. 3.

Diagram of Cross-Section of Moving Coil.

But, as is usual in any engineering design, advantage in one direction is gained at the expense of loss in another direction. Wires of very small diameter offer a correspondingly high resistance to the passage of the current just as pipes of very small size offer very great resistance to the flow of liquid through them, so that, although the number of turns may be increased by using finer wires, the current flowing will be decreased. With the example already taken above, a current of one ampere made four turns round the coil, that is, there were four ampere-turns to generate the torque. If we reduce the diameter of the wires to one-half, the cross section of each wire, and the space it occupies, will be one-quarter ($\frac{1}{2}$ x $\frac{1}{2}$ = $\frac{1}{4}$), and there will therefore be sixteen turns in the same cross section of the coil and having the same total weight. But the electrical resistance of a wire varies inversely as its cross section, therefore the resistance of each turn will be four times that of the single turn of thick wire and, since the current passes in succession through all the turns, the total resistance of the coil will be sixteen times as great (4 x 4 = 16). As is known, by Ohm's law, the greater the resistance of the circuit the smaller the current flowing for any given E.M.F., so that, for the same E.M.F. (electrical pressure) from the thermo-couple, the current will be only one-sixteenth of an ampere, and therefore there will only be one ampere-turn to generate the actuating torque ($\frac{1}{16}$ x 16 = 1), that is to say, the high resistance coil will generate only one-quarter of the torque generated by the low resistance coil. Although many other factors enter into the design, these only modify slightly the effect of using many turns of fine wire, and the examples taken above show the broad conclusion that the higher the resistance of the moving coil the smaller the torque available for a given E.M.F., and therefore, because the E.M.F. depends on the temperature, for a given temperature measurement. Actual trial would show that the maximum torque would be achieved when the resistance of the moving coil equalled the sum of all the other resistances in the circuit, that is, the resistances of the thermo-couple, compensating extension, copper cable, springs and ballast. Limitation of space does not allow full elaboration, but it will be fairly evident that the greater the torque of an instrument the less the liability that it may become inaccurate or out of action due to damaged pivots or other results of rough usage; reference to the concluding paragraphs will reveal figures making this fact still more evident. Instruments in a glass works cannot be as favourably situated as they are in the testing laboratory; some rough usage is inevitable, and thus we see that the greater the torque of an instrument the better its chance of survival.

Unfortunately for the maker, and the user, of the pyrometer, such ideal proportions of the moving coil and other resistances cannot be allowed for reasons which are elaborated below, but it should still be borne in mind that, provided the other elements of design are duly considered and the various resistances in the circuit are properly proportioned, low coil resistance and large currents secure the greatest robustness in service, and since statistics of repairs show that a large percentage are made necessary owing to damage to the indicator or recorder it is difficult to overstress the point. In order that the resistance of the coil shall be as low as possible, pure copper or pure aluminium are practically the only metals used for that part; alloys have much higher resistance than pure metals. It is well known that these pure metals increase their electrical resistance as they get hotter, thus our moving coil will have a resistance which varies with its temperature. This effect is quite important because a rise of 10° C. in the temperature of the moving coil will cause an increase of 4 per cent. in its resistance. It is stated above that the condition for maximum torque would be achieved by making the moving coil equal to all the other resistances, that is to say, the coil would represent half the total circuit resistance. In such a case the rise of 10° C. would increase the total resistance by $\frac{4}{2}$ = 2 per cent. Therefore, since the E.M.F. depends on the temperature measured, the current would be 2 per cent. less, thus the control springs would limit the turning of the coil to a greater extent and the actual temperature reading would be 2 per cent. lower than the correct reading. Since a rise of 10° C. (18° F.) is quite probable between night and day, or due to other causes, the proportions of the circuit resistances resulting in such a drop in reading would not be allowable. It must also be remembered that we have copper cable in the circuit, possibly in positions where it would experience even larger changes of temperature than 10° C. and, although the cable would have a lower resistance than the moving coil the effect of its change in resistance might well be added to that shown above, thus making the "temperature error" more than 2 per cent. Similarly, if a "rare metal" thermo-couple of platinum and its alloys is used, owing to high cost the wires must be thin, and consequently of high resistance, and they also will change their resistance with temperature, so that variation in the length of the thermo-couple exposed to the high temperature may change its resistance to quite a large extent, and this also may act to increase the error. With the "base metal" thermo-couple (for instance alloys of nickel and chromium, nickel and copper and so forth) there is very little change of resistance with temperature and, the metals being cheaper, the wires may be thicker and of lower resistance, so that this particular effect of thermo-couple resistance is then negligible. Nevertheless it will be clear that some modification of the circuit resistances is needed to avoid such large temperature errors.

There are alloys which have very high electrical resistance, which resistance is practically constant at all temperatures likely to be experienced by an indicator. It is therefore easy to make a small coil of high resistance in a compact form; such coils are actually used in standard resistance boxes, bridges and similar apparatus. If we insert in the indicator such a coil and make its resistance equal to twice that of the moving coil the resistance of the copper (or aluminium) coil will be only one-quarter of the total circuit resistance, thus the temperature error for a rise of 10° C. would then be only 1 per cent. In practice, taking into account the other resistances in the circuit, such a resistance coil would be made more than twice that of the copper moving coil, so that the temperature error is reduced to proportions that are reasonably negligible. Because the effect of this resistance coil is to steady the indications and reduce variations, it is usually called the "ballast" resistance, and is shown under that name in Fig. 1. It should be noted that the conditions described above to secure low temperature error are only matters of *proportion* so far. The two examples below would have the same small temperature error, assuming that the control springs do not vary their resistance with temperature, which is approximately true. It is also assumed in this example that the thermo-couple remains at a fixed depth of insertion and therefore does not vary its resistance.

In the example below approximately the same size of moving coil is taken in each case, that is, a coil of thick wire having 40 turns of total resistance, 2.0 ohms would be the same size and weight as one thin wire of 160 turns and resistance 41 ohms, and the net result is that the low resistance instrument will have five times the ampere-turns of the high resistance instrument $\left(\frac{0.08}{0.016} \quad 5\right)$ with equally low temperature error. As explained in other paragraphs the greater the ampere-turns generated in the moving coil, the larger the controlling torque and the more robust the instrument, so that, on the score of robustness, the low resistance instrument has a five times better chance of survival in accurate condition.

Part of Circuit.	*Low Resistance.*	*High Resistance.*
Thermo-couple	0.1 ohms.	... 2.0 ohms.
Compensating Extension ...	0.1 ,,	... 2.0 ,,
Copper Cable	0.3 ,,	... 5.0 ,,
Control Springs	1.0 ,,	... 5.0 ,,
Copper Moving Coil	2.0 ,,	... 41.0 ,,
Ballast Resistance	6.5 ,,	... 145.0 ,,
Total Resistance ...	10.0 ,,	... 200.0 ,,
Proportion of Copper to total resistance	$\frac{2.0 + 0.3}{10} = 0.23$	$\frac{41 + 5}{200} = 0.23$
Temperature error for rise of 10° C.	4% × 0.23 = 0.92%	4% × 0.23 = 0.92%
Assuming an E.M.F. of $\frac{20}{1000}$ volt, the current will be	$\frac{20}{1000} \div 10 = \frac{2}{1000}$ ampere	$\frac{20}{1000} \div 200 = \frac{0.1}{1000}$ ampere
With the same size of of moving coil, number of turns will be*	40 turns	160 turns
Ampere-turns generating controlling torque	$\frac{2}{1000} \times 40 = 0.080$ ampere-turn	$\frac{0.1}{1000} \times 160 = 0.016$ ampere-turn

---

* Allowing for the weight and space occupied by the insulation on the wire.

The intelligent user will now ask why it is that so many of the experts advise, and experienced users employ, high resistance instruments in the face of their obvious greater delicacy, and that brings us to the point of practical application of the various factors elaborated above. The variations in circuit resistance (and consequently in accuracy) due to temperature error have been studied, and it will also be evident, on similar grounds, that the resistance of the circuit must not change largely due to any other causes. Assuming that it is desired to maintain accuracy to within one per cent., the low resistance circuit must not change by more than 0.1 ohm or the high resistance circuit by more than 2 ohms. Considering first the thermo-couple itself, a primary resistance of 0.1 ohm is assumed, and this must not increase by as much as 0.1 ohm., that is, it must not be doubled. Such an assumption is fair for a base-metal thermo-couple of good design; a primary resistance of 0.1 ohm would correspond to a length of thermo-couple of about 3 feet. As already explained, the temperature error due to heating up of the thermo-couple itself is negligible for good base-metals, so that we could use an installation having couples of varying length from 3 feet to 6 feet without introducing any objectionable error. But in the case of rare-metal thermo-couples no such assumption could be made. As already explained the variation of couple resistance due to small changes in length and different depth of immersion would be much more than the allowable margin of 0.1 ohm, so that it is at once evident that the low resistance circuit is not permissible with rare metal thermo-couples.

Next we have to consider the cable resistance. In the low resistance circuit that cable is taken at 0.3 ohm. Assuming a wire of one square millimeter section (about 18 s.w.g.), or the equivalent in stranded form, this resistance would correspond to a length of twin cable of about 33 feet, and since such a cross section of cable is about the smallest that could be considered for reasons of mechanical strength, it is clear that the low resistance circuit is allowable for any instrument in which the cable run is relatively short and not liable to large variations in length. This is particularly convenient in a base-metal portable pyrometer, where one short length of cable only is used and where robustness is of extreme importance. Of course, by using a slightly larger cross section of cable, longer lengths can be accommodated, for instance, if the cross section is 3 sq. mm. (about 14 s.w.g.) the cable run might be 100 feet without exceeding the allowable margin, and it will be noted that variations up to one-third of the length of cable are allowable. Where an indicator is used fairly near the furnace the low resistance circuit is allowable, and it is here that conditions usually demand the maximum robustness.

On the other hand, it is clear that the high resistance circuit is necessary, not only with all rare-metal thermo-couples, but also on base-metal outfits where the cable runs are long and possibly of different or varying length. Considering again the small section cable, a primary length of 550 feet $\left(33 \times \frac{5.0}{0.3} = 550\right)$ would fall within the allowance of 5.0 ohms, and the variation might be 220 feet $\left(33 \times \frac{2.0}{0.3} = 220\right)$ with still larger margins on larger section cable.

Turning for the moment to radiation pyrometers, in which, as already mentioned, the actual sensitive part is a very small thermo-couple, it has first to be noted that the concentration of the radiant heat does not actually heat the thermo-couple to the full temperature measured, but only to a much lower temperature, sufficient E.M.F. being developed by employing a type of thermo-couple which gives large E.M.F. for relatively low temperature; consequently change in the thermo-couple resistance is not large, and in good designs, may be neglected. Change in the cable resistance will come in, but owing to the law upon which such instruments work, not to such a large extent. This law is known as the "fourth power" law, and results that an increase of one per cent. in the absolute temperature of the hot body produces an increase of four per cent. in the E.M.F. developed by the thermo-couple; a numerical example will make this clear. Assume first a hot body at a temperature of 1000° C. (1273° absolute temperature), and that for this temperature the thermo-couple develops an E.M.F. of 0.01 volt, then let the temperature rise one per cent. to 1010° C. (1283° absolute temperature), the E.M.F. will then be $0.01 \times \left(\frac{1283}{1273}\right)^4 = 0.0104$ volt, an increase of 4 per cent., this increase of E.M.F. generating a corresponding increased current in the circuit. Conversely, if, with a steady temperature of the hot body, the resistance of the circuit were increased by four per cent., the fall in current and reading would be only one per cent., so that our allowable margin for variation in cable is four times as large. Actually this "fourth power" law reacts also on the question of proportion of ballast resistance, in fact, except for convenience in calibration, ballast resistance would hardly be needed. In the low resistance circuit, if we omitted the ballast resistance altogether the proportion of copper (moving coil and cable) would be about two-thirds of the resistance $\left(\frac{2.0 + 0.3}{3.5} = 0.66\right)$, so that the increase of resistance for a rise of 10° C. in instrument temperature would be about two and a half per cent. $\left(4 \text{ per cent.} \times \frac{2.0 + 0.3}{3.5} = 2.6 \text{ per cent.}\right)$ but, owing to the "fourth power" law the temperature error would only be just over half of one per cent. $\left(\frac{2.6}{4} = 0.65 \text{ per cent.}\right)$.

It is clear that we might increase the cable resistance much beyond 0.3 ohm, even on a low resistance circuit, without incurring serious risk of a temperature error of one per cent.; for instance, a cable resistance of 2.0 ohms corresponding to a twin cable run of 670 feet in 3 sq. mm. section could be used; therefore, for radiation pyrometers of good design, the low resistance circuit may always be used.

(*To be continued.*)

COMPLETE PYROMETER EQUIPMENT
FOR GLASSWORKS.

The "Resilia" construction, exclusive to FOSTER PYROMETERS, ensures reliable service under the worst conditions. Let us give you full information on this and other special features embodied in our instruments.

FOSTER INSTRUMENT CO.,
LETCHWORTH, HERTS.
"The Pyrometer People."

Telephone: Letchworth 26.
RESILIA
Telegrams: "Resilia, Letchworth."

British Instruments for British Industries.

A NEW TYPE OF FILTER FOR OIL FUEL.

During the last few weeks quite a number of glass works have adopted oil fuel as a means of maintaining furnaces in operation. There are literally dozens of different types of oil burners on the market, the majority of which have some special feature or other which claims recognition. There is one point, however, in which they are practically all on a common base and that is they require clean oil. This, of course, necessitates the installation of some means or system of filtering the fuel supply before it reaches the burners. Until recently this has involved the use of wire gauze or perforated metal, and due to the fact that after being in use for a time the gauze or perforations become clogged, it has been necessary to install the filters in duplicate, with a system of valves, in all cases where continuous operation of the burners is required. In this way one filter was in operation whilst the other was dismantled for cleaning, generally a particularly filthy operation, not to mention the risk of fire in many instances.

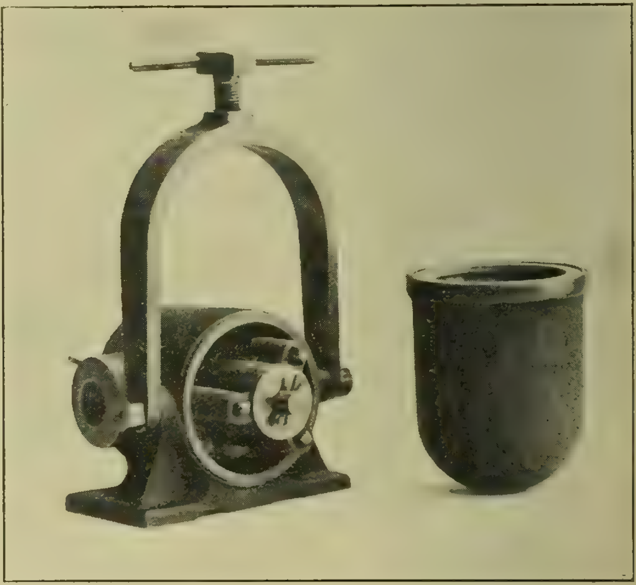
Auto Klean Filter. Capacity 120 gals. per hour.

In the filter described in the following notes, the use of gauze or perforated metal is avoided, as is also the necessity for duplication with its complication of extra valves. Here, straining is accomplished on the principle of passing the oil through a series of fine slots in the wall of a cylindrical cartridge formed by a pile of circular discs mounted on a central spindle and interleaved by thin washers, the thickness of which is a measure of the straining required.

The dirt, fluff or suspended matter contained in the oil is intercepted by the edges of the discs, which in course of time become coated as in the case of gauze. In order to clean the cartridge slots, all that is required is to give the handle situated at the top or end of the strainer, one-third of a turn. This has the effect of revolving the discs which are keyed to the spindle attached to the handle against a series of stationary cleaning blades (three per slot) of special formation. These blades are slightly thinner than the thin washers mentioned previously, and engage the slots as shown, and the action of the revolving cartridge is to scrape the dirt, etc., from the slots, carrying it clear of the cartridge face.

The dirt thus removed settles to the bottom of the strainer and collects in the very large sump provided. It will thus be evident that the strainer can be completely cleaned whilst being used under pressure or otherwise without the necessity of breaking any joint, venting the system or suspending operations in any way.

The cleaning edge of the blades is set obliquely to the periphery of the slot in the cartridge face. The blades have, therefore, a wedging action on the dirt, carrying it from the inside to the outside of the slot, clear of the cartridge face.



Dirt sump removed showing cartridge and cleaning blades.

The ratio between the area of the filtering surface and that of the inlet pipe for the oil is large, usually about 12 to 1, thus reducing to a minmum the restriction to the oil flow. Furthermore, the inlet passage is so situated that any foreign matter has an opportunity of settling out before reaching the filtering cartridge.

From the point of view of mechanical construction, the influence of marine engineering practice is evident, as it is possible to remove the whole of the internal part as one unit, involving the breaking of only one joint, and that a plain one, whilst the gland packing and operating mechanism are not disturbed at all.

As regards space, owing to the absence of change over valves, etc., this is very small, as will be realised when it is stated that the *overall* dimensions of a filter with an approximate capacity of 120 gallons per hour is only about 7½" x 3½" x 3", the weight being 4 lbs.

The filters are made in many sizes and types to comply with the varying conditions in different installations, whilst the extent or degree of filtration or straining is merely dependent upon the thickness of the interleaved washers used in the cartridge. It may be mentioned, however, that these are made as thin as .002", which is equivalent to a gauze having 32,400 holes to the square inch.

Although in these notes fuel oil only has been mentioned, the filters are in use in many industries for removing foreign matter from liquids of all kinds. They are manufactured by Auto-Klean Strainers, Ltd., 1a, New London Street, London, E.C.3.

THE USE OF COMPRESSED AIR.

(*Continued from page* 373.)

efficiency, but, obviously, high mechanical efficiency resulting from light working parts would not necessarily be a true guide to the commercial value of the machine, which first of all must be reliable and durable. As a rule the heavier machine gives the greater assurance of reliability and durability and generally these factors receive prior consideration.

The average mechanical efficiency of modern air compressors is comparable with the average efficiency of high speed forced lubricated steam engines, and reaches 90 to 92 per cent. at full load for multi-stage high pressure machines operating under perfect conditions. It is unusual to secure such high values with low pressure machines, not because the working conditions are any less perfect, but because practical limitations make it difficult to secure the most desirable ratio of weight of moving parts to maximum working load. The mechanical efficiency of low pressure machines, therefore, generally is lower than the values given above and at full load varies from 80 to 90 per cent.

A few examples will serve to show the use of Table III for its primary purpose of calculating the horse power required for a given capacity and pressure, and also for computing compression and overall efficiency.

(*To be continued.*)

The claims of dolomite as a substitute for lime in the manufacture of certain glasses have already been referred to in these columns* and in a recent issue of *Ceramic Industry*, Mr. W. H. Meacham, of the Chattanooga Bottle and Glass Mfg. Co., states that magnesia limes (dolomite) are preferable to high calcium limes for glass manufacture. Mr. Meacham states that they do not powder so easily and have not the same tendency to segregate from the mixed batch when subject to vibration, also he claims they are better fluxes.

Grinding each day, so that only freshly ground material is used, is stated to give quicker melting and fining; the material is crushed to the same degree of fineness as the sand employed and an approximate analysis is CaO 57 per cent., MgO 40 per cent., iron 0.04 per cent.

We have pleasure in publishing the following warning and advice from the Incorporated Society of British Advertisers, Ltd., 134, Fleet Street, E.C.4.

Beware of Offers of Free Publicity.

Despite the exposure of *Truth* and the cautions issued by this and other trade organisations, the practice of offering "free" editorial publicity in mushroom journals bearing impressive titles and apparently emanating from responsible publishing houses, merely as a bait to obtain orders for process blocks of unspecified sizes and at excessive charges, continues to find victims and to discredit advertising.

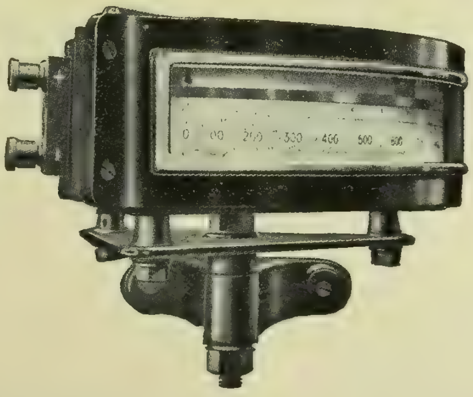
These journals have no genuine subscribers and are therefore absolutely worthless from an advertising point of view. They exist solely upon tricking the unwary into signing innocent-looking orders, which, in cases, have involved the advertisers in considerable losses.

We maintain a careful record of all advertising mediums and shall be happy to put our knowledge of the journals in question at the service of any of your readers who may be approached with offers of "free" publicity.

The Incorporated Society of British Advertisers, Ltd.
E. T. Humphries,
General Secretary.

SIEMENS

Temperature Indicators



The instrument illustrated is only one of the numerous types of temperature indicator which we manufacture. It has a 10-inch scale with bold figuring, so that readings can easily be taken, and is fitted in a strongly constructed metal case with a swivelling wall bracket.

It is designed for use under the severe conditions experienced in works' practice.

If desired, this instrument can be supplied suitable for flush mounting on a switchboard.

Descriptive Pamphlets on application.

SIEMENS BROTHERS & CO., LTD., WOOLWICH, S.E.18.

ESTABLISHED 1858.

---

* Jan., 1924, pp. 91. March, 1924, pp. 152.

SEEDS IN GLASS.

Research work carried out by Mr. A. R. Payne (Chief Physicist of the Hazel Atlas Company) and described by him in a recent article*, shows that sodium chloride is a possible cause of seeds in glass, especially when the glass is subjected to the re-heating and working treatment it receives in the Owens process for making bottles.

It was definitely found that practically all seeds in glassware made in this way contained deposits of sodium chloride. When a tank is being worked slightly beyond its capacity and the glass is seedy as it comes from the refining end, the deposits just mentioned are not the cause of the seeds or blisters. If, however, the glass is clear in the refining end and becomes seedy in the revolving pot, the author contends that it is quite possible that incomplete heating allowed an increased amount of sodium chloride to remain in the glass and that the subsequent heating and working of the glass in the revolving pot caused it to volatilize and the seeds or blisters to form.

With amber glass, owing to the fact that the heat does not penetrate to the lower levels in the tank, the metal is seldom heated sufficiently, resulting in the fact that sodium chloride is almost invariably present in quantities sufficient to cause the metal to be on the verge of becoming seedy, anything abnormal in the operation of the tank causing this to occur.

Motion, exposure to reduced pressure, or increased temperature, all tend to cause sodium chloride blisters to form. The tendency is much greater with the Owens process than with feeders.

A scum over the glass in the melting end acts as a shield, prevents the normal amount of heat from reaching the glass, and therefore allows more dissolved matter (sodium chloride and gases) to remain in the metal as potential sources of seeds.

---

* Glass Ind. Vol. 7, No. 7.

The declared value of glass and glassware imported into Great Britain and Northern Ireland during 1925 was £4,851,620, of which plate and sheet glass represented £1,681,662. For 1924 the figures were £4,580,417 and £1,588,559 respectively.

INDUSTRIAL DESIGNS COMPETITION.

In connection with the Industrial Designs Competition organised by the Royal Society of Arts, the Judges report as follows on the designs submitted in the "glass" section :—

It is a matter for regret on the part of the Judges that they are unable to award any prizes in this section as no individual design attains the all round standard of excellence or originality that merits this distinction. There is a general tendency to overcrowding and elaborate decorations with intricate detail, which is not in keeping with the modern day demand; also, there is a lack of originality in the designs, but quite a good knowledge of the possibilities of production is displayed in both shapes and decorations emanating from the Stourbridge district.

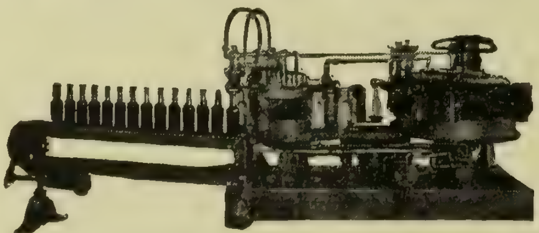
Sub-Section 4.—Glass. No. 870 is "highly commended" and is the outstanding design, mainly for its simplicity of form and decoration, and, in addition, is a complete and practical pattern to produce. This is the work of Thos. William Jones, of the Stourbridge School of Art.

Sub-Section 5.—Glass. No. 326 and 328 are "commended" for a certain amount of originality displayed. This is the work of Charles H. Husselbee, of the Wordsley School of Art—who shows promise in these designs. Design No. 871, of Thomas William Jones, of Stourbridge School of Art, also shows decided ability. John Gill, of Brierley Hill, is "commended" for his salad bowl design (No. 84) which has great merit for excellence of detail, and this is the predominating feature of all his work.

Sub-Section 6.—This is a disappointing Sub-Section, inasmuch as flower vases and bowls offer such great scope for imagination. No. 332. Bowl by Albert Elcock, Wordsley School of Art, is "commended" for its shape and decoration. No. 872, by T. W. Jones, of Stourbridge School of Art, is a distinct and clever design but is not original.

According to the *Pharmaceutical Journal* chemists at Cornell University have discovered a method of using a compound of germanium as a substitute for silica. This new metal is extracted from zinc oxide, it is stated, about one gramme being obtained from a pound of raw material.

AUTOMATIC



May be Worked on Floor Level—No Pit Needed

NARROW NECK AND WIDE MOUTH
BOTTLE BLOWING MACHINE
No Transfer Boy. No Take-Out Boy.
STRICTLY AUTOMATIC
When Operated with Mechanical Feeding Device.
Can be Worked by Hand Gatherers. Speed 10 to 32 Bottles per minute, ranging in size from ¼ oz. to Gallon
LYNCH GLASS MACHINERY COMPANY,
ANDERSON, INDIANA, U.S.A.
Cable Address—"LYNCHNOBOY" ANDERSON
Codes—A.B.C. 5th EDITION, BENTLEY'S, WESTERN UNION

PAVEMENT LIGHTS.

It would be interesting to know how much capital is lying locked up in the mould stores of the different British glass works, the majority of it due to the fact that customers would not accept standard shapes or sizes but demanded some trivial change necessitating a new mould or moulds.

The introduction of the larger automatic productive units has improved matters a good deal in the container section and now the American Department of Commerce (Division of Simplified Practice) has issued a recommendation (No. 49) dealing with pavement, floor and roof lights.

A committee, composed of manufacturers, distributors and users of this type of glass, was formed to decide which of the existing types and sizes would meet all the normal requirements. They came to the conclusion that 10 per cent. of the 80 styles, 120 sizes and 10 shapes that were in existence would meet 90 per cent. of all normal needs.

In the following table will be found the types and sizes it was decided to retain; and the benefit to manufacturers *and* users from this simplification will be obvious to everybody.

Diameter in Inches.	Thickness at supporting Edge.	Diameter of Shield.	Distance on Centres.
	PAVEMENT LIGHTS.	ROUND GLASS.	
a. 2¾	¾″	3¼″	4¼″
a. 3	¾″	3½″	4¼″
	SQUARE	GLASS.	
a. 3½ × 3½	¾″	4″	5″
	FLOOR LIGHTS.	SQUARE GLASS.	
b. 4 × 4	1″	No shield	5″
b. 6⅛ × 6⅛	1″	No shield	7½″
a. 3½ × 3½	¾″	4″	5″
	c. ROOF LIGHTS.	SQUARE GLASS.	
8¼ × 8¼	½″	8¾″ × 8¼″	9⅝″

a. Enclosed in a cast-iron shield. The space between the glass and shield should be filled with plastic compound when protection against the weather or traffic is necessary.
b. Without cast-iron shield.
c. Glass used in this construction to be wire glass and in all cases set in a metal shield.

POOR GLASS MANUFACTURERS!

There would appear to be quite a number of people with a grudge against glass manufacturers and anxious to put them out of business by introducing substitutes. The latest we have heard of comes from Berlin, as shown by the following extract from a local paper:—

"A Berlin professor has discovered how a thin film of steel can be made as transparent as glass. Although very thin, the film can be mounted on a frame, and it is tough enough to be handled with care. The discovery that a metal like iron can be produced in a transparent form may one day lead to the abolition of glass. The new steel is as transparent as the finest white glass."

SILLIMANITE

The High Temperature Resisting Refractory Material.

(*Softening Point above 1800°C.*).

Supplied ground from –10 mesh to –100 mesh.
For all bricks, blocks, flue linings, siege coverings, and glasshouse pots and rings.

For the convenience of users who desire to have sillimanite ready prepared with binder, the following mixtures are also supplied dry or ready for use:—

Slip, Pot and Ring Mixtures.
(PROF. W. E. S. TURNER'S Formulæ).

Tank Block, Brick & Pot Mixtures.
(MR. W. J. REES' Formulæ).

Siege Mixture.
(GLASS RESEARCH ASSOCIATION'S Formula).
For lining the floor siege of pot furnaces and general purposes, patching, etc.

The P.B. SILLIMANITE
COMPANY, LIMITED,
Sole Agents: PAWLE AND BRELICK.
791, SALISBURY HOUSE,
LONDON WALL, LONDON, E.C.2.
Telephone Number - London Wall 4825.
Telegrams - - PLATOONS, LONDON.

Merchandise Marks Battle.

(By OUR CITY CORRESPONDENT.)

Since the last issue of GLASS the interest of the business community in the progress of the Merchandise Marks Bill has quickened very considerably. I pointed out that the President of the Board of Trade had in Standing Committee accepted an amendment which will make it competent for a Committee established under the Bill to require the marking of imported glassware *prior to importation.* It was quite obvious at the time that this radical alteration in the powers conferred by the Bill would put a sharp edge on the hostility of the commercial interests. A few days later a Joint Committee of Trade Sections established at the London Chamber of Commerce (which includes representatives of the China and Glassware Section) passed unanimously a resolution strongly worded as follows :—

"This Joint-Committee has watched with growing concern the progress in Standing Committee of the Merchandise Marks (Imported Goods) Bill which, while recommended by the Government to Parliament as a Bill which aims merely at protecting consumers from fraud, seems to go far beyond what is reasonably necessary for this purpose and includes proposals which, besides interfering unnecessarily with the trade of the country, threaten irreparably to damage many sections of it.

"British firms engaged in foreign trade (both import and export) are now placed in a position of serious uncertainty in view of a continuous series of new regulations which may be promulgated under Clause 2 if the Bill becomes law.

"With regard to the entrepot trade, a prominent feature of the Bill when it passed the Second Reading was a proviso designed to safeguard this trade in respect of all merchandise except foodstuffs. *This important proviso has now been removed during the Committee Stage,* and traders seriously fear a piecemeal destruction of the entrepot trade which has played such an important part in the past prosperity of the country and is of vital concern to the mercantile supremacy of our principal ports."

This was forwarded on July 3rd to the Prime Minister and to the President of the Board of Trade, as well as to every Member of Standing Committee B at the House of Commons, and it secured wide press publicity.

The matter, however, went further than this. The feeling created was so strong that on July 8th the Council of the London Chamber of Commerce was induced to depart from its neutral attitude on the Bill and "as a matter of urgency" unanimously sanctioned a resolution in the following terms :—

"That the Council of the London Chamber of Commerce is of opinion that the country cannot afford, at the present time, voluntarily, and by its own act, to destroy any portion of its existing trade. It therefore views with alarm the acceptance by the Government of an amendment to the Merchandise Marks (Imported Goods) Bill enabling an Order to be made for the marking of manufactured goods before importation, and it is especially disturbed that the Government should have accepted this amendment on the ground that such marking would only be ordered where 'the re-export trade is relatively small,' and the marking before importation can be done 'without substantial injury' to the re-export trade.

"This Council conscious of the fact that the re-export trade, representing some £165,000,000 per annum, is made up of a multiplicity of commodities, see in this the possibility of the re-export trade being destroyed piece-meal. Moreover, it is opposed, on principle, to such comprehensive power for harm being entrusted to any appointed Committee or Minister of the Crown."

The following week the Board of the Manchester Chamber of Commerce added its weight to these representations, all of which were at once reported in the Debates at the House of Commons.

By the time these protests were made the alleged damage in Committee had, of course, been done; but it was quite clear that the importance of these resolutions was felt by the Government especially in view of the fact that the Bill has been ploughing its way very slowly under great difficulty through Committee. After five weeks, involving 15 sittings of the Committee, only two clauses of the Bill were disposed of and the Committee Stage cannot now be completed in time for the Bill to be dealt with on the floor of the House in Report Stage and Third Reading until after the summer recess. The Government, however, is under pressure from agricultural interests, and it is probable that the measure will reach the Statute Book in November or December, though not until the controversy has become still further embittered.

What will be the effect of the Bill on the Glass Trade? I need not deal with the case of goods which already bear a trade mark or the name of some manufacturer, trader or dealer in the United Kingdom. These in any case will in future (or at any rate after June next) require to be marked with an indication of origin; but far wider considerations arise in regard to glassware of all descriptions which at present is sold with no mark at all upon it. The new Bill will not touch these goods at all unless and until a Board of Trade Committee, which is to be set up under the Bill, has investigated the matter and possibly decided that marking shall be required.

Meanwhile the China and Glassware Section of the London Chamber of Commerce has used its influence to get an amendment adopted which will forbid the making of such regulations in cases where the trade can be shown that any kind of branding will disfigure or otherwise injure the goods. It is probable that in the case of certain cut glass (expensive wine glasses, etc.) traders will be able to show that compulsory marking would be detrimental to the goods. On the other hand it is common knowledge that a large number of more common articles are at present quite capable of being marked by sand-blasting; some in fact are thus marked already. Therefore, if the Stourbridge or other British manufacturers press a claim for marking it is quite possible that their request will be granted and an Order made accordingly.

It must, however, be remembered that one of the strongest grounds of opposition to the Bill is the alleged damage it may cause to the re-export trade of Great Britain. The Government has shown that it is keenly alive to the force of this agitation, and although it has not given way to the criticism, nevertheless certain amendments have been accepted which lay upon the Board of Trade an obligation to have most special regard to the circumstances of the re-export trade. Our merchants and shipping houses naturally resent

June Trade Returns.

IMPORTS OF GLASS AND GLASSWARE.

		Quantities.				Value.			
		Month ended 30th June.		Six months ended 30th June.		Month ended 30th June.		Six months ended 30th June.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)...	value	—	—	—	—	4,173	5,800	30,317	32,926
Glass Tubing and Rod for all purposes... ...	cwts.	803	331	3,187	2,989	2.691	1,791	11,176	9.693
Illuminating Glassware	,,	11,336	13,371	65,745	68,933	32,511	41,400	175,074	200,246
Machinery Glassware	,,	3	21	105	50	20	91	1,263	389
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	43,354	61,991	271,806	299 802	121,669	159,150	742,321	819,946
Plate and Sheet Glass	,,	105,989	140,820	552,336	647,786	155,801	194,928	816,626	866,671
Optical Glass (other than worked Elements, e.g. Lenses)	,,	9	1	39	12	1,050	161	2,956	1,339
Bottles and Jars	gross	88,647	134,579	625,486	710,920	58,535	83,804	394,597	427,585
Glass and Glassware not elsewhere specified ...	cwts.	1,752	3,622	10,712	16,404	4,868	8,879	33,249	43,177
Total Value	£	—	—	—	—	381,318	496,004	2,207,579	2,401,972

EXPORTS OF GLASS AND GLASSWARE (BRITISH PRODUCTS).

		Quantities.				Value.			
		Month ended 30th June.		Six months ended 30th June.		Month ended 30th June.		Six months ended 30th June.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)...	value	—	—	—	—	5,446	4,514	34,608	33,158
Tubing and Rod for all purposes	cwts.	125	317	1,550	2,551	840	1,846	11,414	15,031
Illuminating Glassware	,,	477	405	3,156	2,792	4,683	3,128	29,824	24,489
Machinery Glassware	,,	342	217	2,215	1,278	2,927	2,050	15,737	9,994
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	3,268	2,224	16,080	13,436	29,667	22,780	141,443	133,013
Plate and Sheet	,,	68,412	69,702	411,155	453,613	130,209	136,815	804,095	805,677
Optical (other than worked Elements, e.g. Lenses)	,,	4	6	64	32	172	206	1,568	803
Bottles and Jars	gross	24,665	20,210	163,672	138,815	23,412	20,413	166,349	137,425
Manufactures, not elsewhere specified	cwts.	577	802	4,085	4,159	3,710	4,197	22,789	24,371
Total Value	£	—	—	—	—	201,066	195,949	1,227,827	1,183,961

EXPORTS OF GLASS AND GLASSWARE (FOREIGN AND COLONIAL MERCHANDISE).

		Quantities.				Value.			
		Month ended 30th June.		Six months ended 30th June.		Month ended 30th June.		Six months ended 30th June.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)...	value	—	—	—	—	292	634	3,296	2,658
Glass Tubing and Rod for all purposes ...	cwts.	3	—	10	8	32	9	134	102
Illuminating Glassware	,,	94	110	798	858	626	918	6,278	7,174
Machinery Glassware	,,	—	—	1	4	—	2	26	85
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	700	786	4,141	4,048	4,518	4,961	25,742	25,546
Plate and Sheet	,,	255	424	1,644	2,646	316	420	2,405	2,913
Optical Glass (other than worked Elements, e.g. Lenses)	,,	11	8	31	25	80	96	242	263
Bottles and Jars	gross	1,125	2,866	7,984	8,400	1,041	2,413	8,287	7,275
Glass and Glassware not elsewhere specified ...	cwts.	230	25	453	258	665	211	2,670	1,161
Total Value	£	—	—	—	—	7,570	9,664	49,080	47,177

legislation which will oblige them to betray to their overseas customers the origin of the goods they sell. This would be simply to invite the customer to go direct to the foreign manufacturer and leave the British trader severely alone. Such a development would not only damage the very valuable entrepot trade of this country, but would probably react upon the sales of the British manufacturer, since the London or Liverpool shipping house which at present receives Colonial orders for mixed consignments of glassware almost always includes in its despatches a considerable quantity of British-made glassware. A composite order could not, however, be accepted unless the shipping house were in a position to include certain Continental lines with the British goods.

If for any reason (whether it be a tariff or a merchandise marks) the shipping firm loses the business, then to this extent export trade in British goods is likely to suffer.

A vivid example of this danger has arisen in the case of the Lace Duties which were imposed in July, 1925. Within twelve months more than one million pounds worth of re-export business was lost to this country ; but *at the same time the exports of British lace fell by more than* 25 *per cent.* on the previous year, involving a net decrease in British exports amounting to over £600,000. The glass merchants claim that while the figures may be dissimilar for different trades, nevertheless the same tendency is bound to develop from restrictive legislation of any kind which will destroy the present freedom of our leading ports as entrepot markets.

There is also, of course, the rather difficult case of Mounting Glassware. Members of the trade will recollect that in January, 1922, at the original Safeguarding of Industries Enquiry, the manufacturers of Mounting Glassware were parties to an application for a tariff, but that (with the solitary exception of one firm) they withdrew the claim as a result of representations made to them by the Sheffield and Birmingham Silversmiths, who pointed out that for purposes of their large Eastern and other markets they require a plentiful supply of Mounting Glassware from Czecho-Slovakia, especially in types of articles which are either wholly or practically unobtainable in this country. The firms in this country who manufacture glassware for mounting purposes were not prepared to run counter to the manifest interests of the Sheffield and Birmingham mounters, who are their principal customers. As a result of this *impasse* mounting glassware was excluded from the Safeguarding tariff which was imposed in August, 1922.

Similar considerations now arise in regard to Merchandise Marks. It is not reasonable to suppose that the Birmingham and Sheffield mounters will welcome any regulations which require the marking of glassware (which is to them raw material) with an indication of Czecho-Slovak origin. I have in front of me an example of a French lens which is mounted so as to form a reading glass. The silver mounting is stamped with the trade mark of a Birmingham firm which is, of course, quite entitled to mark its goods as British. Under Clause 1 of the new Bill such marking will in future be forbidden, i.e. unless at the same time the lens within the frame is branded as foreign, or French —which obviously it cannot be.

On the whole it must be admitted that the question of Merchandise Marks is very complex and that wisdom requires that we should go very slowly in the matter. In the case of a tariff which proves injurious to ourselves we can remove it, but in the case of Merchandise Marks damage once done may prove irretrievable. If once you send your customer to the next door shop for any purpose or for any reason, it is quite on the cards that you will never get him back again to your own shop ; and at the present time (as the London Chamber of Commerce resolution insists) we simply cannot afford " voluntarily and by our own act " to send our customers to some other shop.

If it is possible to mark glassware and if British manufacturers desire that their productions shall be recognised as British and that the consumer shall have an opportunity of recognising them as such, then there is nothing whatever to prevent the British manufacturer branding his goods. Until he is willing to do this it seems a little unreasonable that he should require everyone else to brand their goods, especially when it can be shown that such requirement is in danger of proving a boomerang to the detriment of British trade.

Railway Rates.

The Railway Rates Tribunal, after some years of work, appears to be approaching the end of its weary task. Until its findings are published it is impossible to say how far the efforts of the traders have been worth while. The new rates which the Railway Companies are asking power to charge show very serious increases over the rates hitherto prevailing, even though the latter are, in the opinion of the business world, already much too high ; and with every desire to be fair to the Railway Companies, manufacturers and merchants in this country are bound to point out that there is a limit to the burdens which our industries can bear in the matter of transport charges. In any case it appears certain that we have got to face an increase in railway freights. Directly this question is definitely resolved there will no doubt be a violent outcry from the industrial and commercial interests all over the country. But it is only fair to point out that meanwhile the fight against this development has been left in the hands of a comparatively few organisations who have taken the trouble to face the issue.

Vitreous Enamel Colours.
Stains for Glass.
Oxides for Colouring Glass Metal.
Selenium Metal.
Selenate and Selenite of Soda.

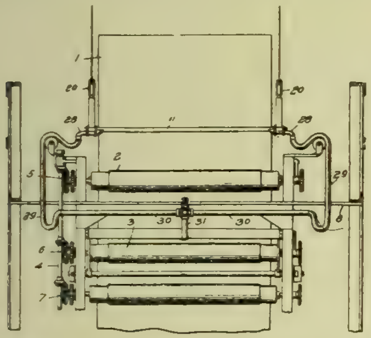
GROUND BONE FELSPAR, FLINT, FLUORSPAR, QUARTZ, STONE, WHITING, ETC.,
CARBONATE & SULPHATE OF BARYTES
OXIDES OF ANTIMONY, ARSENIC, CHROME, COBALT, SMALTS, COPPER, IRON MANGANESE, NICKEL, TIN TITANIUM URANIUM ZINC, ETC
TRADE CERAMIC MARK
WENGERS, LTD.
CERAMIC COLOURS & CHEMICALS
ETRURIA.
STOKE-ON-TRENT.
England.
Samples & Price Lists Sent on Demand.
COLOURS FOR POTTERS, GLAZED BRICK MANUFACTURERS, & GLASSMAKERS.
PREPARED ENAMELS FOR CAST & SHEET IRON, COPPER & JEWELLERY.

Limespar.
Phosphate of Lime.
Nitrate of Soda.
Nitrate of Potash.
Opavetro for Opacifying Glass.
Alumina, Oxide and Hydrate.

United States Patents.

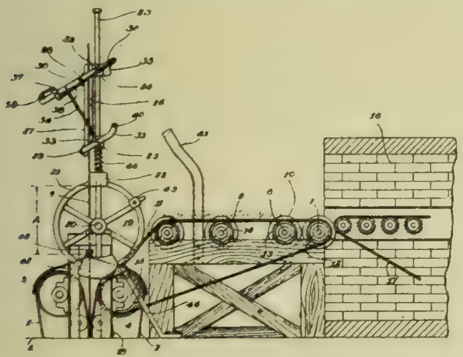
GRANTED JUNE 8th, 1926.

1,587,547.—**Apparatus for Severing Glass Sheets.** Travis Oakes, Mount Vernon, Ohio, assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed November 25, 1925. Serial No. 71,452. 7 Claims. (Cl. 49—50.)



1. An apparatus for separating sections from a continuously formed sheet of glass, comprising electric heating means extending transversely of the sheet so that it moves along with the sheet during the heating operation, a nozzle at the edge of the sheet supported in fixed relation to the heating means, so as to move along therewith, fluid supply means therefor, and means for controlling the flow of fluid through said supply means.

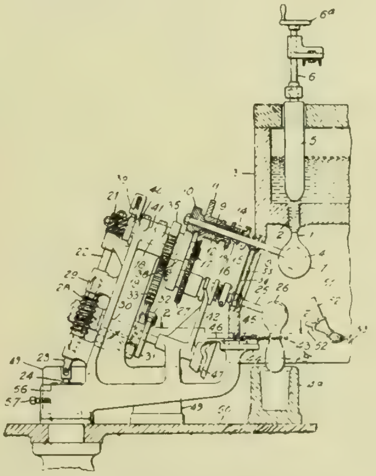
1,587,549.—**Apparatus for Handling Glass Sheets.** William Owen, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed February 16, 1924. Serial No. 693,241. 7 Claims. (Cl. 49—17.)



1. The combination with a vertical drawing machine, for drawing a continuous sheet or ribbon of glass of a driven carrier lying above the machine and extending laterally from the side of the glass sheet emerging from the upper end thereof, a transfer frame pivoted adjacent the level of the carrier between the end of the carrier and the line of draw, so that in one position it extends upwardly along such line of draw in approximate alignment therewith and in its other position it extends laterally overlapping the carrier, so that a glass sheet on the frame is engaged by the carrier cutting off means for the glass, and clamping and steadying means above such last means movable upward with the sheet and engaging the upper portion thereof before and after the cutting off operation, the said transfer frame being adapted to support the glass sheet cut from the continuous sheet during the movement of such frame from an upright position to a horizontal position.

3. The combination with a vertical drawing machine for drawing a continuous sheet or ribbon of glass, of a driven carrier lying above the machine and extending laterally from the side of the glass sheet emerging from the upper end thereof, a transfer frame pivoted adjacent the level of the carrier between the end of the carrier and the line of draw, so that in one position it extends upwardly along such line of draw in approximate alignment therewith and in its other position it extends laterally overlapping the carrier so that a glass sheet on the frame is engaged by the carrier, cutting off means for the sheet means carried by the frame for supporting a glass sheet (cut from the continuous sheet) upon such frame when in its upright position, and clamping means for the sheet movable upward therewith for supporting it during a portion of its upward travel.

1,587,985.—**Feeding Mould Charges of Molten Glass.** Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed March 31, 1921. Serial No. 457,298. 11 Claims. (Cl. 49—5.)



2. The method of forming a mould charge of molten glass from a flowing stream, which consists in winding the stream upon itself to form a gather, pulling the gather away and separating it from the stream, stopping the winding action and suspending the gather, and severing a mould charge from the suspended gather.

1,587,986.—**Multiple Glass Feeder.** Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed March 31, 1921. Serial No. 457,300. 30 Claims. (Cl. 49—5.)

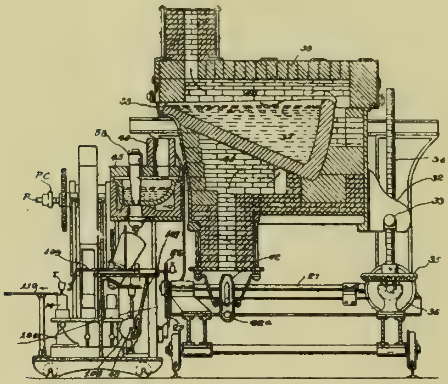
1. The method of obtaining gathers of molten glass from a supply, which consists in winding the glass in succession upon a plurality of rotating gathering implements, and increasing the distance between the implements to pull their respective gathers apart.

1,588,179.—**Leading-in Wire for Glass Vessels.** Ernst Friederich, Berlin-Charlottenburg, Germany, assignor, by mesne assignments, to General Electric Company, Schenectady, N.Y., a Corporation of New

York. Filed August 30, 1921, Serial No. 496,943, and in Germany February 10, 1916. 4 Claims. (Cl. 176—36.) (Granted under the provisions of the act of March 3, 1921, 41 Stat. L., 1313.)

3. A lead-in wire consisting of an alloy of iron with tungsten having a coefficient of expansion within close range of the coefficient of expansion of glass.

1,588,393.—**Glass-feeding Apparatus.** Theodore C. Steimer, deceased, late of Pittsburgh, Pa.; by Charles M. Steimer, executor, Zanesville, Ohio, assignor, by mesne assignments, to Hartford-Empire Company, a Corporation of Delaware. Original application filed February 12, 1910, Serial No. 543,582. Divided and this application filed December 31, 1924. Serial No. 759,173. Substitute for application Serial No. 753,690, filed December 3, 1924. 12 Claims. (Cl. 49—55.)



1. The method of delivering glass from a source of supply through a spout, which comprises flowing a temperature modifying medium around and in contact with the walls of said spout, and then delivering such fluid into the spout interior above the glass line.

GRANTED JUNE 15th, 1926.

1,588,510.—**Silver-Glass Mirror Making.** William S. Wear, Excelsior Springs, Mo. Filed August 25, 1923. Serial No. 659,416. 1 Claim. (Cl. 91—68.3.)

A method of silvering glass consisting in placing the glass to be treated in a substantially horizontal plane, cleaning the surface of the glass, applying a solution of tin chloride to the cleaned surface, washing the surface with hot water to remove excess chloride solution, mixing and applying a solution to the surface thus treated while said surface is wet, said solution having a proportion of 10 ounces of cold water, 4 ounces of hot water, and 4 ounces of a solution formed of 2 ounces of Rochelle salts and 16 ounces of water, mixed with 1 ounce of a solution containing 8 ounces of silver nitrate and 6 ounces of 28 per cent. concentrate of ammonia, permitting the solution thus applied to remain on the surface a pre-determined length of time, then applying a hot solution containing 1 pint of water, 2 ounces of a solution formed of 16 ounces of distilled water mixed with 2 ounces of Rochelle salts and ¼ ounce of an additional solution formed of 8 ounces of silver nitrate mixed with 6 ounces of 28 per cent. concentrate of ammonia, and subsequently cleaning the surface of the glass and permitting the same to dry.

1,588,603.—**Apparatus for Annealing Glassware.** Vergil Mulholland, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed August 27, 1925. Serial No. 52,751. 12 Claims. (Cl. 49—46.)

1. Apparatus for annealing glassware, comprising a tunnel, a plurality of flues associated with said tunnel, a fire box, communicating with one of said flues at a point adjacent to the entrance end of said tunnel, a fire box communicating with another of said flues at a point remote from the entrance end of said tunnel, and means for causing heated gases to flow through the portions of said flues located between said fire boxes in opposite directions with respect to each other.

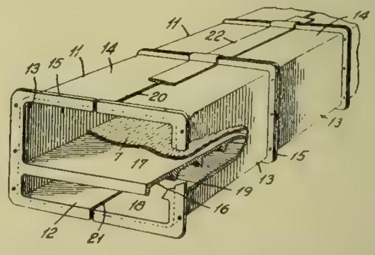
1,588,680.—**Process of Making Glass Letter Plates.** Raymond F. Hancock, Marion, Ind., assignor of one-half to James Boyce, Laketon, Mich., and one-half to Harry F. Anderson, Marion, Ind. Filed February 5, 1925. Serial No. 6,951. 2 Claims. (Cl. 49—79.)

1. The method of producing concave-convex glass sign-character plates which consists in rolling a mass of molten glass into a sheet between two rollers, depositing the sheet directly upon a die plate, and exerting fluid pressure against the sheet to force the latter into conformity with the die plate.

1,588,852. **Method of Making Mould-Blown Glass Articles.** Thomas A. Nilan, Hurricane W. Va. Filed August 23, 1924. Serial No. 733,725. 8 Claims. (Cl. 49—69.)

1. The method of making mould-blown glass articles which includes providing a mould-blown glass article with an opening other than the below opening, and specially applying heat to the portions of the article adjacent the opening, substantially as described.

1,588,905.—**Apparatus for Annealing Glass-ware.** Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed November 2, 1925. Serial No. 66,180. 17 Claims. (Cl. 49—46.)



11. Apparatus for annealing glassware comprising a tunnel section having a metallic wall and a flue formed integrally with said wall.

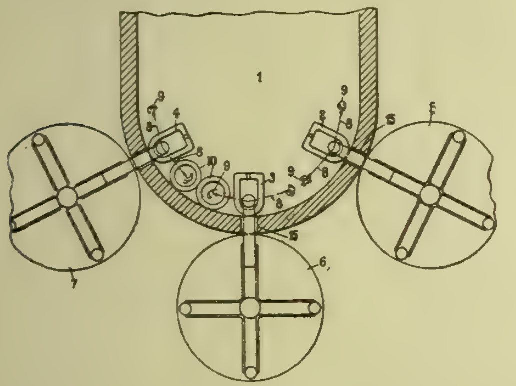
17. Apparatus for annealing glassware, including a tunnel comprising a plurality of self-supporting metallic sections arranged in end-to-end relation, each of said sections having a passageway for ware and a passageway for a temperature-controlling medium, said passageways being separated by a wall common to both of said passageways.

1,589,304.—**Feeding Molten Glass.** Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire

Company, a Corporation of Delaware. Filed December 8, 1925. Serial No. 74,085. 3 Claims. (Cl. 49—55.)

1. Glass gathering apparatus, comprising a receptacle for molten glass, means for delivering formed lumps of viscous glass therefrom, and knives for severing each lump as formed, said knives being adjustable along the path of delivery of such lumps.

1,589,337.—**Removal of Glass from Glass Furnaces.** Heinrich Severin, Sasbach, near Achern, Baden, Germany. Filed September 25, 1925. Serial No. 58,651, and in Germany September 23, 1924. 4 Claims. (Cl. 49—5.)



1. A method of withdrawing glass directly from a glass furnace having definite dipping chambers and clarifying rings for the mould, consisting in this : that the mould is inserted into the molten glass of the dipping chamber and the glass adhering to the mould, when the latter is withdrawn, is cut off and thrown into the clarifying rings externally of the dipping chamber, as and for the purpose set forth.

GRANTED JUNE 22nd, 1926.

1,589,654.—**Method of Moulding Glass and Apparatus Therefor.** Paul R. Murdock, Paden City, W. Va. Filed April 28, 1925. Serial No. 26,501. 6 Claims. (Cl. 49—1.)

1. In a device of the character described, a mould comprising a lower casing having a fluid chamber, an upper casing having a fluid chamber, one of said casings being provided with cavities in its face, means for creating a difference in pressure in said chambers, and means for communicating the pressure difference to opposite sides of a sheet of glass arranged between said casings.

1,589,787.—**Method of Laying Glass Sheets on Worktables for Grinding and Polishing.** John W. Butler, Chicago, Ill., assignor to United States Gypsum Company, Chicago, Ill., a Corporation of Illinois. Filed September 14, 1923. Serial No. 662,620. 2 Claims. (Cl. 51—278.)

1. The method of preparing plates of glass for grinding and polishing consisting in applying upon a flat table having a plurality of tapered apertures therethrough a layer of plaster in a plastic condition which plaster fills the apertures and presents an even upper surface, placing the plate of glass to be treated upon the upper surface of the plastic layer and allowing the plastic layer to dry and set, adhering evenly to the table and under side of the plate of glass, the excess moisture of the plastic layer evaporating uniformly through the plurality of apertures in the table.

1,589,910.—**Glass-cutting Apparatus.** John Waterloo, New Eagle, Pa., assignor to Window Glass Machine Company, Pittsburgh, Pa., a Corporation of New Jersey. Filed October 28, 1922. Serial No. 597,569. 2 Claims. (Cl. 33—32.)

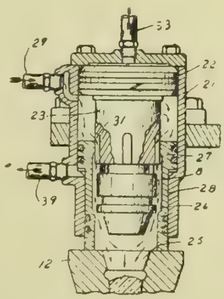
1. The combination with a glass cutting table, of a bridge mounted to span the table, a cutter and a cutter support, the bridge comprising a pair of substantially parallel rods and the cutter support having means adapted to be snapped over said rods and make frictional engagement therewith to hold the cutter support at any desired position along the bridge, substantially as described.

1,590,132.—**Heat-Insulating Composition and Process of Making the Same.** Clark S. Teitsworth Lompoc, Calif., assignor to The Celite Company, Los Angeles, Calif., a Corporation of Delaware. Filed August 12, 1924. Serial No. 731,631. 8 Claims. (Cl. 106—18.)

1. The process of manufacturing porous heat insulating bodies, consisting in calcining disintegrated diatomaceous earth, mixing the resulting calcined porous silica with a binder and water to form a plastic mass, moulding the mass to shape, indurating the moulded product, and drying the indurated product.

GRANTED JUNE 29th, 1926.

1,590,423.—**Glass-forming Machine.** Albert N. Cramer, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Filed May 9, 1924. Serial No. 712,140. 18 Claims. (Cl. 49—9.)

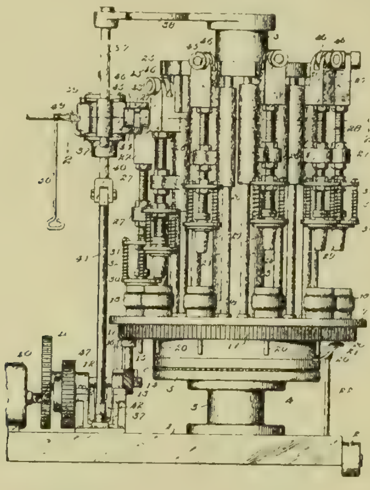


6. In a glass blowing machine, the combination of a blank mould open at its upper end to receive a charge of glass, a blowing head movable into engagement with the mould, a piston in said head, and a mould capacity reducing element carried by said piston and movable thereby into the mould.

1,590,481.—**Continuously-revolving Press.** Thomas Stenhouse and David Stenhouse, Washington, Pa., assignors to Hazel-Atlas Glass Co., Wheeling, W. Va., a Corporation of West Virginia. Filed May 12, 1924. Serial No. 712,754. 21 Claims. (Cl. 49—35.)

1. In a glass pressing machine, a continuously revolving table, a plurality of moulds carried thereby, a plunger for each mould, a movable member, and means carried by said member for engaging the plungers to successively

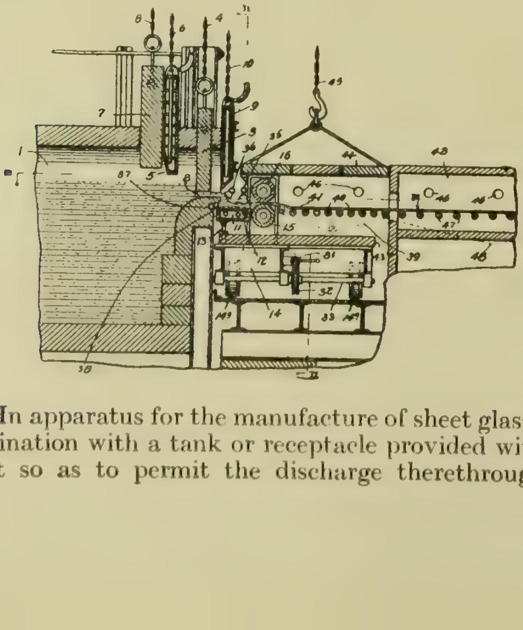
raise and lower them, said means adapted to operate the plungers while the table and plungers continue to rotate.



1,590,819.—Apparatus and Process for Making Sheet Glass. Frederick Gelstharp, Tarentum, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed October 7, 1924. Serial No. 742,181. 11 Claims. (Cl. 49—3.)

1. In apparatus for the manufacture of sheet glass, the combination with a tank or receptacle provided with an outlet, so as to permit the discharge therethrough of molten glass under the head pressure of the tank, a stationary spreading table in position to receive the molten glass from said outlet of a width much greater than that of said outlet, a sizing roll over the table intermediate the ends thereof, a pair of traction rolls in advance of the sizing roll for engaging the upper and lower sides of the sheet and pulling it over the surface of the table and beneath the sizing roll, and a lehr in advance of said traction rolls provided with means for carrying the glass therethrough.

1,590,820.—Apparatus for Making Sheet Glass. Frederick Gelstharp, Tarentum, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed October 7, 1924. Serial No. 742,182. 6 Claims. (Cl. 49—3.)



1. In apparatus for the manufacture of sheet glass, the combination with a tank or receptacle provided with an outlet so as to permit the discharge therethrough of molten glass under the head pressure in the tank, a stationary spreading table in position to receive the molten glass from said outlet of a width much greater than that of said outlet, a pair of sizing rolls at the forward end of the table of a length greater than the width of said outlet, and a lehr in advance of said rolls.

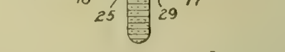
1,590,855.—Apparatus for Forming Optical Blanks. Thomas Rotheram, Creighton, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed February 9, 1923. Serial No. 618,087. 5 Claims. (Cl. 49—7.)

1. The combination with a tunnel heating chamber provided with a continuous carrier for optical blanks and a moulding or pressing machine adjacent the exit end of the chamber, of automatic transfer means between the carrier and the pressing machine, and reversing means for turning the blanks upside down in their passage to the pressing machine.

1,590,864.—Rouge-feeding Apparatus. Jacob Soderberg, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania Filed July 9, 1925. Serial No. 42,526. 3 Claims. (Cl. 51—263.)

1. In combination with a polishing machine, a conduit containing a mixture of rouge and water under pressure, and a discharge outlet for conducting the mixture to said machine including a pipe passing through the wall of the conduit, and having its inner end extended into such conduit to a point remote from said wall.

1,590,924.—Method of and Apparatus for Feeding Glass. Orville A. Bridges, Zanesville, Ohio, assignor, by mesne assignments, to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed November 25, 1918. Serial No. 264,015. 22 Claims. (Cl. 49—55.)



4. The method of serving predetermined quotas of glass from a mass of molten glass contained within a receptacle having a bottom flow orifice, which consists in permitting a body of glass to flow by gravity through said orifice, in inserting a punty through said orifice into said body of glass whereby the flow through said orifice is retarded and the body of glass depending from said orifice is transferred to and supported by said punty, in allowing said body to stretch to reduce its diameter and to form a top contracted neck thereto, in interrupting the flow through said orifice by upward movement of said punty and then in severing said neck during said upward movement and permitting said body to drop by gravity.

22. Apparatus for feeding molten glass, having in combination a receptacle having an opening in its floor,

a block having an orifice of downwardly decreasing diameter in said opening, a refractory ring having a similar orifice secured below the block and a reciprocating plunger movable in the outlet formed by the two parts.

GRANTED JULY 6th, 1926.

1,591,090.—**Reversal and Control of Regenerative Furnaces.** George H. Isley, Worcester, Mass., assignor to Morgan Construction Company, Worcester, Mass., a Corporation of Massachusetts. Filed February 15, 1923. Serial No. 619,185. 14 Claims. (Cl. 263—15.)

1. Reversing apparatus for a gas fired regenerative furnace, comprising a valve associated with the gas regenerator passages of the furnace for reversing the gas supply, in combination with independently reversible blowing devices associated respectively with each of the air regenerative passages of said furnace.

1,591,175.—**Glass-working Machinery.** Roy D. Mailey and Wilford J. Winninghoff, East Orange, N.J., assignors to Cooper Hewitt Electric Company, Hoboken, N.J., a Corporation of New Jersey. Filed September 6, 1924. Serial No. 736,353. 11 Claims. (Cl. 49—1.)

1. In apparatus for joining tubular glass, in combination means for heating the glass at and near the points of jointure, means for varying the amount of heat emitted from said heating means, and means for varying the pressure of the atmosphere within the joined parts.

1,591,179.—**Process of and Apparatus for Making Sheet Glass and other Articles.** Hubert A. Myers, Toledo, Ohio. Filed July 26, 1920. Serial No. 399,163. 11 Claims. (Cl. 49—17.)

5. In apparatus for making sheet glass, the combination of means for supplying the molten glass, means for drawing a sheet from the mass of molten glass, means for deflecting the direction of travel of the sheet from a vertical plane to a horizontal plane, a shoe over which the glass travels from one plane to the other, and means for interposing a preheated fluid between the glass and the surface of said shoe, thereby to prevent the sheet or soft glass from dragging on the shoe, thus avoiding injury to the surface of the glass.

1,591,831.—**Glass-making Machine.** Albert A. Icenhour, Detroit, Mich., assignor to himself, Benjamin F. Neumann, Emil C. Patzer, and Wesley E. Garrison, trustees, all of Detroit, Mich. Filed November 8, 1922. Serial No. 599,700. 16 Claims. (Cl. 49—3.)

1. In a glass machine, a bait, means to lift the same to draw a sheet of glass, and a swingable support having asbestos covered rollers to receive the sheet and position it for entrance to the lehr, substantially as set forth.

BRITISH PATENTS.

The following abstracts are taken from the Illustrated Official Journal of Patents with the special permission of the Controller of H.M. Stationery Office.

Printed copies of the full specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C., price 1/- each.

250,614.—**Marking Electric Lamp Bulbs, etc.** British Thomson-Houston Co., Ltd., Crown House, Aldwych, London.—(Assignees of Donovan, J. F.; 1869, Chapman Avenue, East Cleveland, Ohio, U.S.A.) April 9, 1926, No. 9430. Convention date, April 9, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Classes 39 (ii) and 100 (ii).)

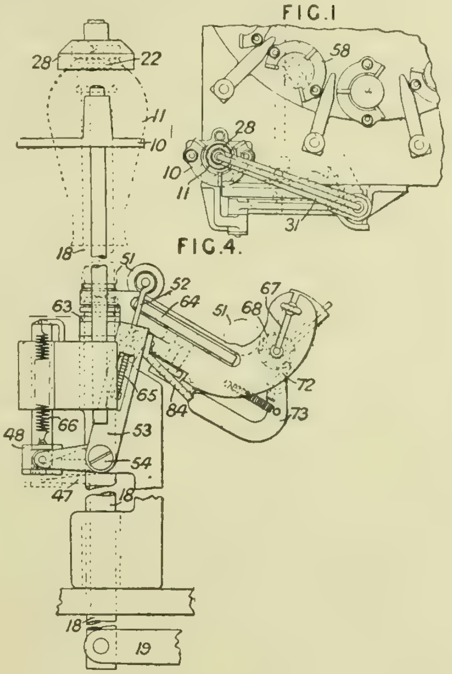


FIG.1
FIG.4.

A machine for printing a mark on electric lamp bulbs, etc., operating in combination with a second machine, for example the sealing-in and exhausting machine, described in Specification 232,953, is provided with a transfer mechanism for automatically removing the bulbs from the printing-machine and delivering them to the second machine. The bulbs 11 are placed in the holder 10 of the printing-machine, where a mark is applied to the inside by a vertically operating stamp 22, the bulb being held by a suction device 28. An arm 31 that carries the suction device is then raised to lift the bulb from the holder 10, and then swings horizontally to deliver the bulb into a holder 58 of the sealing-in machine. The stamp 22 is resiliently mounted on the end of a rod 18 adapted to be reciprocated by a cam-operated lever 19, and is held in its lowest position by a stop 63 while being inked by a roller 51. This is mounted on arms 52 telescoping in arms 53, while the roller is held on its track by springs 65. As the rod 18 approaches its lowest position, the end of a slot in it depresses a finger 47 and a member 48 against the action of a spring 66, and the member 48 rocks the arms 53 about a pivot 54 to effect the inking of the stamp. Ink is supplied to the roller 51 from a fountain 67 by means of a roller 68 adapted to be rotated by a pawl 72 mounted on an arm 73 pivoted on the shaft of the roller and operated by one of the arms 53 striking it. In its passage to the stamp the roller 51 passes over an ink distributing disc 64, which is rotated by a pawl carried by a bracket 84 attached to an arm 53.

250,634.—Annealing Glassware. Frink, R. L., Grove House, Walton Road, East Molesey, Surrey. Dec. 13, 1924, No. 29995. (Class 51 (ii).)

Annealing-furnaces; tunnel furnaces.—Glass articles are conducted singly and spaced apart through a number of inclined heating and cooling chambers in an atmosphere travelling through the chambers under the tendency of the heated gases to rise, the direction of flow of the gases being in some chambers the same as and in other chambers opposite to the direction of travel of the articles. The chambers 1 . . 7 are arranged side by side or one above another, and are connected by inclined curved runways 11 . . 16, the articles being carried by conveyor belts 8 supported by guides 9 in each chamber. The delivery end of each chamber is arranged above the receiving end of the next chamber, and the runways are sufficiently inclined to allow the articles to slide down them by gravity and be picked up by the conveyer belt of the next chamber, the articles travelling through the chambers and runways 1, 11, 2, 12 . . 6, 16 to the chamber 7 from which the final discharge takes place. Doors or valves 10 are provided along each chamber to control the rate of flow of air into or out of the chambers and burners 17 regulate the temperature within the chambers. The flow of gas in the chambers 1 . . 4 is in the same direction as the travel of the articles while in the chambers 5 . . 7 it is in the opposite direction; the rate of this flow may be separately adjusted in the several chambers so that it is greater than equal to or less than the rate of travel of the articles. The air admitted to the chambers 5, 6 may be preheated and the chambers may be lined or covered with insulating material.

FIG.I.

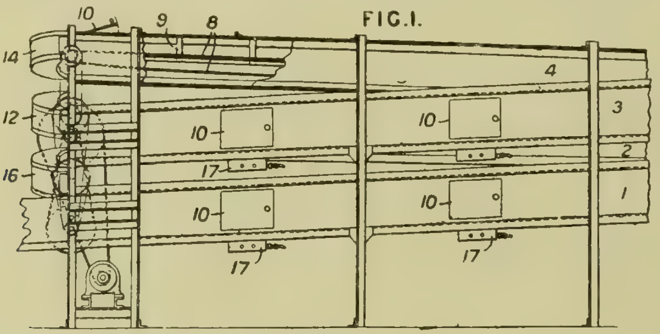
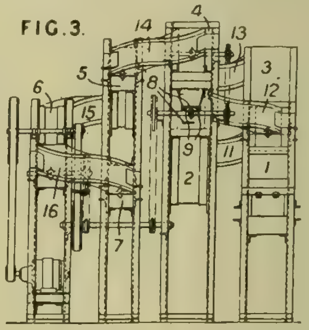
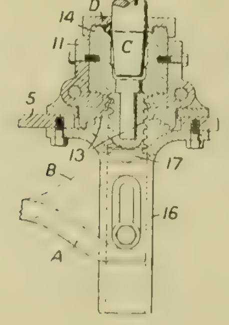


FIG.3.



250,659.—Glass Manufacture. Schmunk, C. E., 300, Cornell Avenue, Crafton, Pennsylvania, U.S.A. Jan. 14, 1925, No. 1161. (Class 56.)

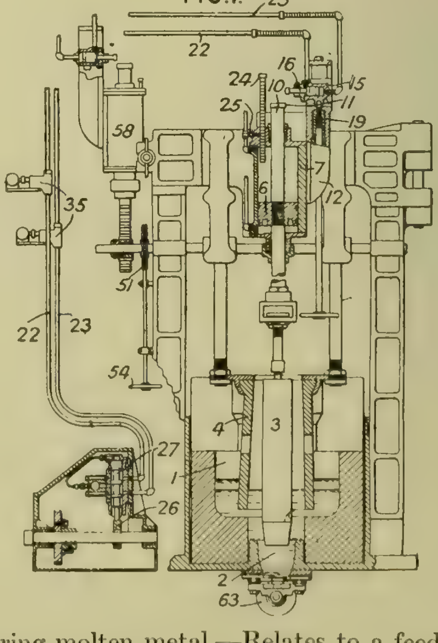
FIG.I



Moulds, construction of; pressing.—A mould comprises a number of sections pivoted to a support and an operating member consisting of a plunger centrally arranged with respect to the sections, movement of the plunger serving to open or close the sections. The mould is adapted for use with any of the usual types of automatic presses in which the mould is carried on a rotary table 5. The mould sections 14 are secured to carriers 11 which are pivoted on the table, and are formed with segmental gears 13. These gears engage with teeth formed on a plunger 17 which slides in a guide 16 secured below the table and coaxial with the mould. The plunger is reciprocated by fixed cams A, B during the rotation of the table, and its reciprocations open or close the mould sections. A cap plate D fits on to the top of the mould sections when closed, and prevents them from spreading under the pressure of the pressing-plunger C. The movement of the plunger 17 to open the mould also raises the finished article out of the mould.

250,664.—Glass Manufacture. Rankin, C. H., 1233, Main Street, Wellsburg, West Virginia, U.S.A. Jan. 15, 1925, No. 1247. (Class 56.)

FIG.I.



Delivering molten metal.—Relates to a feeder of the kind in which a plunger or sleeve is moveable to and from a discharge orifice and an adjustable stop is provided to limit the extent of the movement. According to the invention, means are provided for periodically removing from and returning to the operative position one or more stops, so that it is possible to deliver a succession of "gobs" or mould charges of different weights. Means are also provided for varying the cross-sectional area of the discharge orifice, and for controlling the level of the glass around the reciprocating plunger.

Varying the plunger stroke. The feeder comprises a forehearth having at its front end a well 1, Figs. 1 and 4, in the floor of which is the discharge orifice 2. A reciprocating plunger 3 controls the formation of the gobs of glass discharged through the outlet, and a sleeve 4, concentric with the plunger and capable of vertical adjustment, controls the flow of glass to the orifice. The plunger 3 is carried by the piston rod of a cylinder 7, and is reciprocated by the admission of compressed air to the ends of the cylinder. The piston 6 has a tail rod 10 which extends beyond the cylinder and terminates in a collar 11. The device for limiting the stroke of the piston consists of a small air cylinder 15, Fig. 1, arranged with its axis at right angles to the cylinder 7 and carried by a bracket 12 secured to the cylinder. The position of the small cylinder 15 is adjustable vertically by means of a screw 19, and the piston rod 16 of this cylinder can be moved into or out of the path of the collar 11. The rod 16 thus acts as a stop for limiting the movement of the plunger 3, and by mounting a number of these small or stop cylinders at different heights, it is possible to control the stroke of the plunger 3, the rods 16 projecting either above or below the collar 11. Another form of stop consists of a rod 24 mounted in the end of the cylinder 7 and secured in its adjusted position by a screw 25. By mounting such a stop at each end of the cylinder 7, the maximum stroke of the plunger can be limited, lesser variations in the stroke being controlled by the cylinders 15. Compressed air for operating the pistons of the cylinder 7 is controlled by means of a timing-mechanism comprising cams 26 which operate distributing-valves 27, and the timing of the cams can be carried by mechanism such as that described in Specification 213,351. The speed at which the plunger 3 moves is controlled by cushion valves 35 in the pipe lines 22, 23 between the valve 27 and the ends of the cylinder 7. Each valve 35 consists of a spring-operated ball which admits air to, but prevents its escape from, one end of the cylinder. The escape of air is controlled by a by-pass valve the opening of which is determined by a wedge-shaped member operated by a small air cylinder. The regulation of the escape of the air controls the speed of the piston 6 and therefore of the plunger 3. The sleeve 4 may be adjusted vertically, in order to vary its distance above the floor of the wheel 1, by means of a wormwheel 51 turned by a handwheel 54. Alternatively, the sleeve may be moved by an air cylinder 58 the movements of its piston being controlled in the same way as that of the piston 6.

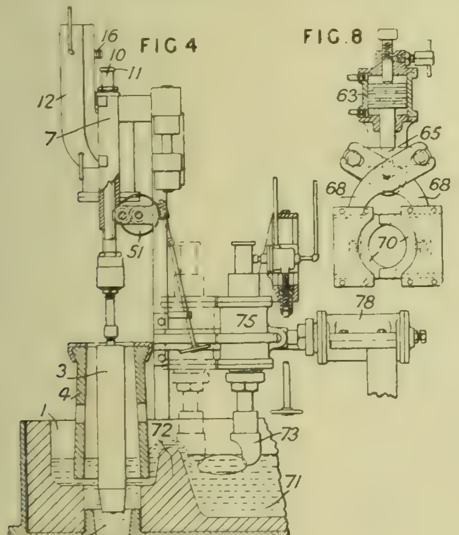


FIG 4

FIG.8

Varying the size of the discharge orifice. The outlet 2 may be expanded or contracted by means of two plates 70, Figs. 4 and 8, having opposed semicircular edges, which slide over one another beneath the orifice. The separation of the plates is controlled by an air cylinder 63 the piston rod of which is connected to a crosshead 65 that operates levers 68 pivoted to the plates 70. The movement of the plates may be coordinated with that of the plunger 3.

Feeding glass to the plunger. For controlling the level of the glass in the well 1, a paddle-shaped impeller 23, Fig. 4, is used to propel the glass along the forehearth 71 over a wall 72 into the well 1, in the manner described in Specification 105,672. The paddle is reciprocated horizontally by an air cylinder 78 and vertically by another cylinder 75. The stroke of the pistons of these cylinders is varied in the same way as that of the piston 6, so that the path of the paddle can be varied in order to regulate the amount of glass fed to the plunger.

250,794.—**Glass Manufacture.** Marks, E. C. R., 57, Lincoln's Inn Fields, London.—(Danner, E.; 260, Hudson Avenue, Newark, U.S.A.) June 30, 1925, No. 16828. (Class 56.)

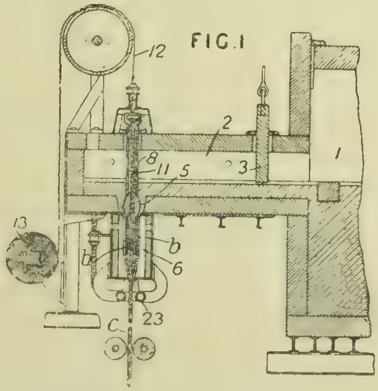


FIG.1

Drawing; forming reinforced glass.—A method of forming reinforced sheet glass consists in flowing molten glass downwards in two layers, passing a wire fabric or netting between the layers, and causing the two layers of glass to come into contact with the wire netting to form a single sheet enclosing the wire. The glass flows from a tank 1 into a forehearth 2 the bottom of which is formed with an elongated slot or discharge opening 5. A refractory slab 8 is supported in the slot 5, and the glass flows down the sides in two streams b which unite at the bottom to form a single sheet. The slab is formed with an opening 11 through which a band of wire netting 12 drawn from a roll 13, is passed. The wire passes downwards, and a reinforced sheet c is formed by the two streams b of glass uniting with the wire. In order to prevent the formation of air bubbles in the sheet and to cause the glass to unite with the wire, air is exhausted from the space 11 within the slab. A chamber formed by walls 6 encloses the lower part of the slab and is heated by burners 23. The hot gases from these burners regulate the condition of the glass flowing down the slab and impart a fire polish to the finished sheet.

251,072.—**Surfacing Glass.** White, A. E., 88, Chancery Lane, London.—(Pittsburgh Plate Glass Co.; Frick Building, Pittsburg, U.S.A.) March 21, 1925, No. 7700. (Class 60.)

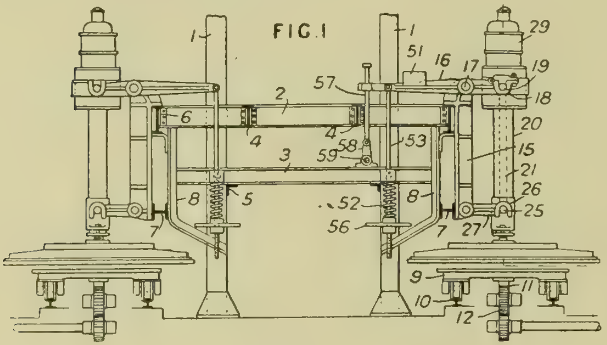


FIG. 1

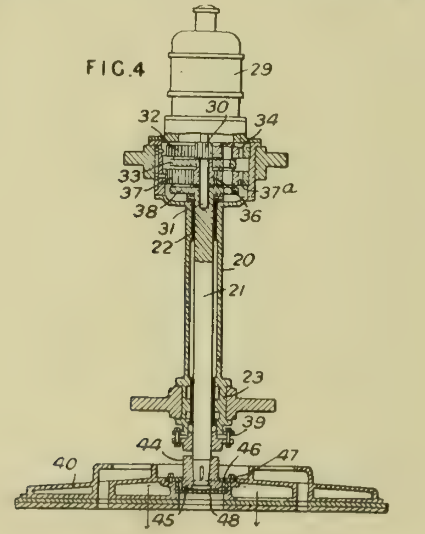


FIG. 4

In a machine for surfacing glass, etc., having a surfacing unit mounted and guided for vertical movement on a framework and comprising a vertical runner shaft journaled in an upright casing, a runner secured to the lower end of the shaft, counterbalancing means and means for driving the runner shaft, the surfacing unit is releasably suspended upon the framework so as to be removable bodily therefrom. The arrangement shown comprises two series of grinding and polishing units suspended over tracks 10 for cars 9, which carry the glass sheets and are fitted with racks 11 actuated by gears 12 to move the cars along, each unit being removably mounted on a casting 15 on outward extensions of a framework 1 . . 8 extending longitudinally between the trucks. The casing 20 of each grinding unit has trunnions 19 supported in hook members 18 on a lever 16 pivoted at 17 to the coating 15 and other trunnions 25 engaged by hook members 26 on pivoted arms 27. The weight of the grinding unit is counterbalanced by a weight 51 and spring 52, the tension of which is adjustable by a wheel nut 56 on the threaded end of the rod 53 connected to the lever 16. The runner shaft 21 is mounted on a bearing 22 at the top of the casing 20 and a bearing in a box 23 at the lower end of the casing, and is driven by a motor 29 at the top of the casing through reduction gearing of the planet ring type. A pinion 30 on the motor shaft 31 drives a number of planet pinions 32 mounted on a disc 33 and meshing with an internal gear 34 on the casing. The disc 33 is rigid with a sleeve pinion 36 engaging a series of gears 37 which mesh with an internal gear 37a on the casing and are mounted on a disc 38 integral with the runner shaft 21. The casing 20 and gear casing are filled with lubricating oil, leakage of which is prevented by a stuffing box 39 below the box 23 of the lower bearing. In a modification, the runner shaft is driven from the motor by worm gearing. A rocking driving connection is provided between the shaft 21 and the runner 40 to enable the latter to accommodate itself in known manner to the surface of the glass. The shaft 21 terminates in a block 44 having a head 45 with peripheral teeth engaging teeth on the inner periphere of a collar 46, which is secured by bolts 47 to the runner and holds the head 45 in place. The lower surface of the head 45 is of convex shape and rests on a plate 48. Means are provided whereby all the runners of a series may be raised. Each lever 16 is fitted with a headed rod 57 connected by a crank 58 to a shaft 59 extending along the series of machines. By turning the shaft 59, all the levers 16 are pulled down and the runners lifted.

251,138.—**Glass Manufacture.** Evans, W. E., 27, Chancery Lane, London.—(Europäischer Verband der Flaschenfabriken Ges.; Düsseldorf, Germany.) June 20, 1925, No. 16013. (Class 56.)

FIG. 19.

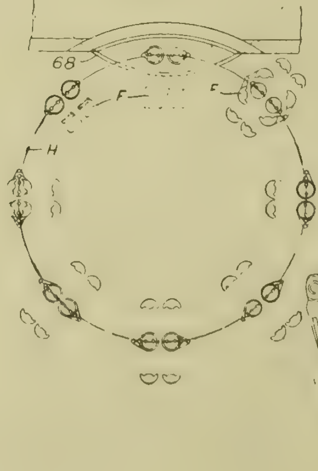
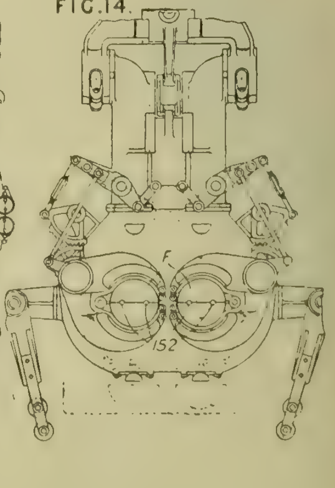


FIG. 14.



Blowing.—Relates to a machine of the Owen type in which several bottles are made at the same time by each unit of moulds. According to the invention, the moulding-spaces in each mould are arranged on a line which is transverse to the radial centre line of the arm carrying the mould, so that corresponding moulding-spaces on each arm travel in the same path. The invention is shown applied to a machine of the kind described in Specification 29251/12, and 13356/13, a plan of the finishing moulds of a unit being shown in Fig. 14. Two moulds F are mounted on each arm, and each mould is formed with two mould cavities 152 so that four bottles are blown simultaneously. The cavities 152 are arranged on a line perpendicular to a radius of the machine extending between the moulds, or the cavities may be arranged on the arc of a circle concentric with the axis about which the machine rotates. The parison mould cavities are arranged in the same manner, and all travel in the same circle H, Fig. 19. The moulds thus travel in substantially the same path through the metal in the rotating tank 68, and metal of the same temperature and consistency will be supplied to all the moulds.

251,158.—**Glass Manufacture.** Tennant, W. J., 111, Hatton Garden, London.—(Lockwood, L. V.; 165, Broadway, New York, U.S.A.) Aug. 20, 1925, No. 20918. (Class 56.)

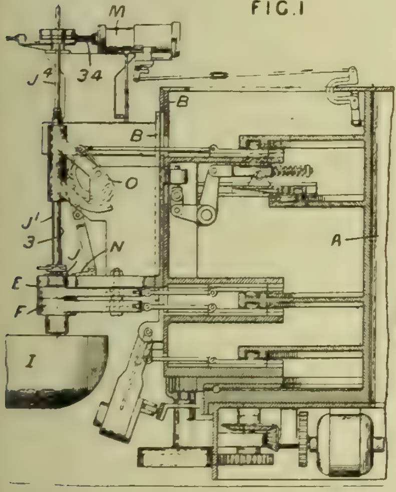


FIG. 1

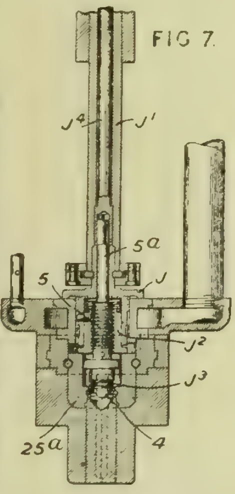


FIG 7.

Blowing.—Relates to bottle-making machines of the Owens type and consists in providing means for enabling such a machine to be used for the production of bottles having internally-screwed mouths. The machine comprises a stationary central pillar A, Fig. 1, a rotating frame B carrying the different moulds, and means for dipping the parison moulds F into a rotating tank I to enable the metal to be sucked into the parison moulds. The mandrel for forming the initial opening in the parison is carried by a head J which is carried by a tubular shaft J^1. This shaft is formed with a rack 3 by which the head J may be raised and lowered. The mandrel J^3, Fig. 7, has a threaded tip 4 which forms the required thread in the mouths of the bottles, and it also has a threaded shank 5 which screws into a nut J^2 mounted in the head J. The shank 5 extends upwardly as a smooth stem 5a which engages with the lower end of a shaft J^4 journaled in the tubular shaft J^1. The upper end of the shaft J^4 is feathered in a gear wheel which engages a rack 34, Fig. 1, secured to the piston rod of a cylinder M operated by compressed air. In operation, the mandrel is lowered into the ring mould E by a toothed segment O, which engages the rack 3 on the tubular shaft J^1 and is operated by suitable cams. Air is admitted to the cylinder M and the shaft J^4 is rotated, so that the mandrel J^3 is also rotated and is screwed down into proper relation with the parts 25a of the ring mould. After a charge of metal is gathered by suction applied through passages in the head J, the shaft J^4 is rotated in the reverse direction, so that the mandrel is screwed out of the thread formed in the parison. The tubular shaft J^4 is then raised to lift the head J away from the ring mould, and a blowhead N slides over the ring mould to complete the blowing of the parison.

251,632.—**Glass Manufacture.** Riechers, F., 5, Ostenhellweg, Dortmund, Germany. April 28, 1926, No. 11164. Convention date, May 4, 1925. (Class 56.)

Rolling.—Relates to a method of preventing plate glass from warping or cracking after it has been formed and before it is brought into the lehr. According to the invention, a glass plate is partly cooled or heated, after it leaves the rolling-machine, in order that all parts of it may be brought to a substantially uniform temperature before it is put into the lehr. The plates are formed by rollers a and are delivered on to conveying tables b. The forward end of a plate, which is first formed, is cooler than the rear end, and this difference of temperature is removed either by heating the forward part of the plate or by cooling the rear part, or both.

251,951.—**Joining Metal to Glass.** Naamlooze Vennootschap Philips' Gloeilampenfabrieken, 6, Emmasingel, Eindhoven, Holland. April 1, 1926, No. 8921. Convention date, May 11, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Classes 39 (i), 39 (ii) and 56.)

An alloy to be used for sealing in or to glass consists of iron, chromium, and aluminium. Generally, the proportion of aluminium does not exceed 5 per cent. and may be less than 1 per cent. A suitable composition consists of 25 per cent. of chromium, 0.5 per cent. of aluminium, and the remainder of iron, but the exact composition will vary according to the kind of glass used. The alloy can be used for fixing the electrodes and other metal parts of electric discharge tubes to the glass, and also for sealing rods, wires, plates, etc., in or to glass.

NOTICE TO GLASS MANUFACTURERS.

GLASS HOUSE POT MAKER requires about two or three months' Pot-making at Works. Will be at liberty at the end of September. First-class workman, high class references. No objection to Continental Works.—Apply Fred Mayfield, 42, Town Street, Tinsley, Sheffield.

Latest British Patents.

Applications for Patents.

15653—June 22, 1926. (Germany June 22, '25). Scheidhauer & Giessing Akt-Ges. Manufacture of refractory bricks.

15740—June 22, 1926. (Holland June 25, '25). Naamlooze Vennootschap Philips' Gloeilampenfabrieken. Apparatus for sealing wire supports in glass rod.

15799—June 23, 1926. (United States June 29, '25). British Thomson-Houston Co., Ltd. Frosting Glass.

15956—June 25, 1926. W. Taylor Kapella Ltd. Pads for polishing glass, &c.

15962—June 25, 1926. (United States Nov. 20, '25) H. H. Bub r. Separating dust from gases.

16022—June 25, 1926. R. H. Haddan. (Corning Glass Works). Refractory articles or castings.

16027—June 25, 1926. E. R. N. Hyde. Siphons.

16053—June 25, 1926. (Germany June 25, '25). Dr. Stien Glasfabrik Akt-Ges. Manufacture of moulds, &c., for manufacture of glass.

16072—June 25, 1926. V. H. Seymer. Vickers Ltd. Packing cases for bottles.

16202—June 28, 1926. C. Whittle. Method of hermetically sealing bottles, &c.

16216—June 28, 1926. G. Frenkel. Closing means for jars, &c.

16226—June 28, 1926. H. J. Dallas. Disc for sealing bottles, &c.

16266—June 28, 1926. L. S. Longenecker. Refractory blocks.

16300—June 29, 1926. T. Teisen. Oil firing arrangement for glass, &c., furnaces.

16455—June 30, 1926. Siemens & Halske Akt. Ges. Means for testing combustion gases.

16557—July 1, 1926. R. Haddan. (Corning Glass Works). Substances transparent to ultra-violet light.

16564—July 1. J. A. Fullilove. W. Haddan. Fixing glass to sloping roofs.

16589—July 1, 1926. (Miller. Inc. W. J.). Machine for manufacturing marbles, &c.

16620—July 2, 1926. Pax Engineering Co. Froth eliminating attachment for bottle-filling, &c., machines.

16665—July 2, 1926. Haddan (Meinecke). Bottle closures.

16954—July 7, 1926. (United States Sept. 14, '25). Tucker, Reeves & Beatty. Delivering measured quantities of glass.

16956—July 7, 1926. J. T. Wood. Wood's Automatic Glass Feeder Co., Ltd. Timing apparatus for glass feeding device, etc.

17497—July 13, 1926. W. R. Hales. Stoppers for bottles, etc.

17528—July 13, 1926. (United States July 13, '25.) British Thomson-Houston Co., Ltd. Fusing silica.

17663—July 14, 1926. F. M. Cupit. N. C. Kennedy. Production of etching transfers.

17670—July 14, 1926. R. H. Carpmael. Closure for containers, etc.

17688—July 14, 1926. T. Esser. Sprinkler closure device for bottles, etc.

17777—July 15, 1926. R. G. Bailey. Bottles, etc.

17792—July 16, 1926. J. Conti. Mirrors.

Specifications Published.

230846—March 14, 1924. F. Rosengarth. Moulding of cells and cases from glass and the like.

236925—July 10, 1924. Herzogenrather Glaswerke Bicheroux et Cie Ges. Table for receiving and transferring rolled glass plates.

240448—September 24, 1924. Libbey-Owens Sheet Glass Co. Sheet-glass drawing apparatus.

240489—September 24, 1924. British Thomson-Houston Co., Ltd. Apparatus for and method of making vitreous silica.

242597—November 6, 1924. Soc. Anon. d'Exploitation des Brevets Cousin Dite le Chauffage Industriel. Air-blast device for semi-water gas-producers.

243322—November 22, 1924. J. Boucher and A. Boucher. Glass making furnaces.

247206—February 27, 1925. G. Le Roy. Stained glass.

251632—May 4, 1925. F. Riechers. Methods and plant for manufacturing plate glass.

249868—March 24, 1925. British Thomson-Houston Co., Ltd. Apparatus for feeding glass bulbs and similar articles into a machine.

249894—April 19, 1924. Divided Application on 232625. J. Paisseau. Supports for use in the manufacture of glass or enamel beads.

253675—May 7, 1925. L. T. Payne. Apparatus for delivering measured quantities of liquid by volume from bottles and similar vessels.

253789—August 8, 1925. M. M. A. De Guedalia. Methods for ornamenting ordinary or crystal glass.

253844—March 25, 1926. J. H. Reincke and Unipressure, Ltd. Device for controlling the quantity of air supplied to a furnace in dependence of the constitution of the waste products.

254085—June 9, 1925. A. E. White (Mississippi Glass Co.). Sheet Glass for use in windows and the like.

254174—Aug. 1, 1925. General Electric Co. Manufacture of glass.

254175—Aug. 1, 1925. General Electric Co. Manufacture of Glass.

254380—March 31, 1925. A. McNish and Glass Machinery Corporation Ltd. Means for operating valves or other mechanism for use, more particularly, in connection with glass moulding machinery.

254505—June 25, 1925. A. Breisig. Blocks for regenerating chambers.

254580—Oct. 30, 1925. V. F. Feeny (Illinois Pacific Glass Co.). Process of annealing glass.

Specifications Open to Public Inspection.

253866—June 20, 1925. Soc. Anon. des Manufactures des Glaces et Produits Chimiques de St. Gobain, Chauny & Cirey. Apparatus for the manufacture of sheet glass.

253947—June 22, 1925. Scheidhauer & Giessing Akt. Ges. Process for the manufacture of refractory bricks from chamotte and casting clay slips.

254281—June 24, 1925. Hartford Empire Co. Apparatus for feeding molten glass.

254311—June 25, 1925. Naamlooze Vennootschap Philips' Gloeilampenfabrieken. Apparatus for sealing wire supports in a glass rod.

254316—June 29, 1925. British Thomson-Houston Co., Ltd. Methods of and apparatus for frosting glass articles.

254330—June 25, 1925. Glasfabrik Akt. Ges. and Stein, Dr. Proceeds for the manufacture of moulds or tools used in the manufacture of glass.

255118—July 13, 1925. British Thomson-Houston Co., Ltd. Apparatus and process for fusing silica.

Patents, Trade Marks, Inventions.—Advice, Handbook and Consultations free. King's Patent Agency, Ltd., Director B. T. King, C.I.M.E.; Regd. Patent Agent, G.B., U.S., and Canada, 146a, Queen Victoria Street, E.C.4, and 6, Quality Court (near Patent Office), London, W.C. 39 years' references. 'Phone: Cent. 682.

"Method of Getting Viscous Glass Charges." The owners of British Patent No. 131586 desire to dispose of the same or would grant a licence to work the invention on royalty terms. Particulars may be obtained from TECHNICAL RECORDS LTD., of 59-60 Lincoln's Inn Fields, London, W.C.2.

"Method and Apparatus for Separating Quantities of Molten Glass or like Material from Mass." The owners of British Patent No. 109,782 desire to dispose of the same or would grant a licence to work the invention on royalty terms.—Particulars may be obtained from TECHNICAL RECORDS, LIMITED, of 59-60, Lincoln's Inn Fields, London, W.C.2.

"Improvements in and Connected with Injector Mechanism." The owners of British Patent No. 121,971 desire to dispose of the same or would grant a licence to work the Invention on royalty terms. Particulars may be obtained from TECHNICAL RECORDS, LIMITED, 59-60, Lincoln's Inn Fields, London, W.C.2.

GLASS

THE RECOGNIZED ORGAN OF THE GLASS INDUSTRY
Published on the Tenth of Each Month.

Single Copies - - - - One Shilling
Annual Subscription - - 10/6 post free

GLASS PUBLICATIONS Ltd.
TECHNICAL PUBLISHERS,
Talbot House,
Arundel Street,
Telephone: CENTRAL 5985. **Strand, London, W.C.2.**

CONTENTS.

PAGE
Editorial Notes ... 403
Practical Notes on the Thermal Endurance of Glass.—By H. V. E. Renn ... 404
✓Glass Etching by Hydrofluoric Acid: Minute Observations.—By James Scott, M.S.C.I., M.A.C.S., M.E.H.A. ... 409
✓The Annealing of Glass: A Non-Technical Presentation.—By A. N. Finn ... 411
The Use of Compressed Air (*continued*).—By Robert Wilson ... 419
The Selection of Electric Motors ... 423
Trade Notes ... 425
A New Method of Marking Glass ... 427
Belgian Glass Trade ... 427
The "How and Why" of Pyrometer Resistance ... 429
Catalogues ... 435
Books Received ... 435
Mechanical Gas Producers ... 436
July Trade Returns ... 437
The Opening of the Glassmakers' Camp ... 438
United States Patents ... 439
British Patents ... 442
Latest British Patents ... 447
British Industries Fair, 1927 ... 448

Editorial Notes.

In the August issue of this Journal our City Correspondent dealt with the Merchandise Marks Bill and its effect on the glass industry, but his remarks were chiefly concerned with the attitude and arguments adopted and put forward by that section of the business community which is opposed to the legislation in question.

In view of the fact that the opponents of the Bill regard its progress with such great concern and that in order to more clearly define their position in the matter we may perhaps generally refer to them as being the "importing" section, the commercial interests of which are naturally to a large extent contrary to those of British manufacturers, we feel that in this present instance an explanation of the other view point is necessary.

For some time past the general public of this country have been asked in numerous ways to "Buy British," and there is not the slightest doubt but what there has been a most decided response to these requests. In fact it is quite safe to say that the vast majority of people will and do purchase British made products wherever possible, subject to them being available at prices which are reasonably competitive with those of the imported article.

It will be obvious, of course, that in order for this "Buy British" movement to be thoroughly effective it is essential that the purchasing public should have some means of distinguishing between goods of British and foreign manufacture, and to give them the necessary facilities to do so is the object of the Merchandise Marks Bill, which will "require an indication of origin to be given in the case of certain imported goods."

Many foreign made articles are sold here because of the impression prevailing that similar goods are not made in this country, and whilst, naturally, this is certainly true in some cases, the Bill should do much to show how few and isolated they are.

A proposal that the imported articles should be marked prior to importation has met with considerable opposition, although in many instances, we may take bottles as an example, such marking during manufacture would not entail the slightest extra cost nor present any practical difficulties, but would give the additional advantage that they would carry this foreign brand during the whole of their existence.

Of course, it is not suggested that this method is practicable for all glassware, as obviously many objects would be defaced by marking in this way, but there are a large number which could be so marked, in fact, for which it is the only feasible method, if the branding is to be of real use.

As will be seen from our Correspondent's article last month, there is also decided opposition to the "marking before importation" on the grounds that it will interfere with the re-export trade of this country. As a matter of fact, we understand that goods definitely imported for re-export will not be affected by the Bill, so that it would seem as if this objection was without real foundation and could be obviated with little difficulty.

The Bill is simply a means of enabling the British public to assist British manufacturers if they so desire. It is not in any way in the nature of a tariff or duty and imposes no extra financial handicap on imported articles. Consequently we feel that if, as is confidently expected by its sponsors, the Bill will help British manufacturers, then our Glass Manufacturers are entitled to any advantages that might accrue. They should bear in mind, however, that the Bill is not yet passed, and that even when such is the case, before the manufacturers in any industry can enjoy the benefits an application for an Order must be made, and that any such application on behalf of the Glass Trade will be undoubtedly strongly opposed by the importing interests.

[GLASS *will deal with all matters pertaining to the industry in an impartial manner, consequently the Editor does not necessarily associate himself with the opinions expressed by his contributors.*]

Practical Notes on the Thermal Endurance of Glass.

By H. V. E. RENN.

The previous articles upon this subject have dealt with the properties of glass that affect its power to withstand inequality of temperature according to the well-known equation

$$F=\frac{P}{aE}\sqrt{\frac{K}{sc}},$$

where F is the thermal co-efficient of endurance. The factor now remaining to be discussed is the density, s, which, according to the above equation, produces an effect inversely proportionate to its square root.

Density.

By no means an unimportant factor in the thermal endurance, the density is of interest in a variety of other ways. The waves and cords, technically termed striae, that streak throughout the mass of a sample of glass wanting in homogeneity, correspond to those portions of the sample varying in density, while a knowledge of the density of the component glasses used in the manufacture of cased-glass is sometimes an advantage. Further, in the manufacture of glass for optical purposes the density gives a measure of the refractive index in both similarly constituted compounds and those of entirely different composition.

In determining the density of a glass it is necessary to keep in mind that certain glasses are quite considerably affected by moisture. When precise measurements by weight are being conducted upon glass of any description, attention must be paid to the state of the surface of the glass, since a film of moisture is condensed upon it depending on the nature of the glass and the humidity of the atmosphere. It was established by Kohlrausch that the glasses which condense least moisture on their surfaces are those which best resist the attack of water. If the density is determined by the usual method of weighing the substance immersed in water, then the extent to which the glass undergoes solution should be known with precision. The extreme solubility of some glasses,* however, render it necessary to employ some neutral liquid such as toluene, in place of water.

It is also important that the glass should be perfectly homogeneous. This is evident when it is considered, as previously mentioned, that the presence of striae in a glass indicate a variation in density.

The effect of the presence of strain upon the density has been investigated by English and Turner.† A series of glasses were examined in which the MgO content was gradually increased, one sample (A) being taken from a rod of the glass which had been air-cooled only and the other (B) from a slab which had been annealed without the entire elimination of the strain. The density was determined on the two samples of each glass in the series and plotted against the content of MgO, as shown in Fig. 1.

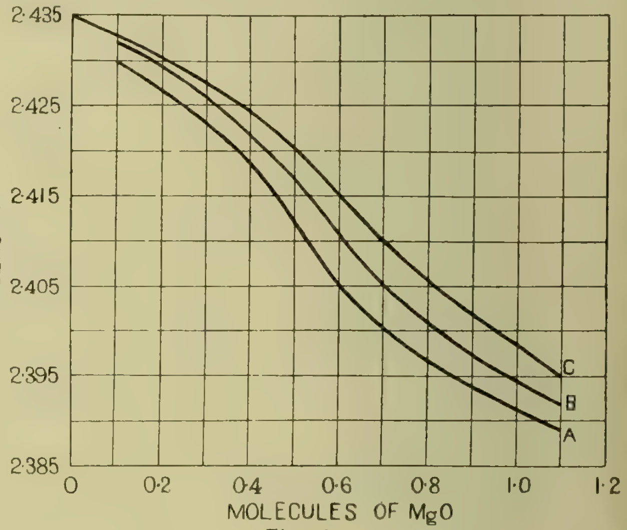


Fig. 1.

The curves (approximate only) show a considerable difference and indicate the necessity of thorough annealing. The rod and slab were subsequently annealed and the densities were then found to coincide, as indicated by curve C.

For the purpose of the density test, the glass sample was crushed and sieved and the portions between 10- and 30-mesh carefully selected and annealed. The annealing process was carried out by placing a powdered sample in a hard glass tube, heating to the annealing temperature and allowing to cool very slowly. The density was then determined upon 10 grammes of the sample by immersing, according to the solubility and the extent of corrosion by moisture, in either toluene or water contained in a specific gravity bottle. All air contained between the particles of glass were removed by pressure. The weighings were carried out at the standard temperature of 20° C.

Relation between Density and Chemical Composition.

A great amount of work has been done upon the relation existing between the composition of glass and its density, the first systematic investigations probably being those of Winkelmann and Schott. As was the case with the other properties of glass, appropriate numerical factors were assigned to the oxides by means of which the density could be computed with tolerable accuracy. Errors between observed and calculated values, however, occurred up to 10 per cent., so that obviously further work remained to be carried out upon the subject. This has been done comparatively recently and by the use of a revised set of factors, very close agreement can be obtained between actual and calculated values. In Winkelmann and Schott's investigations the formula adopted was

---

* Peddle, J., Soc. Glass Tech., 1920, IV, 8; English and Turner J., Soc. Glass Tech., 1920, IV, 126.

† J. Soc. Glass Tech., 1920, IV, 153.

$$\frac{100}{D} = \frac{p_1}{d_1} + \frac{p_2}{d_2} + \frac{p_3}{d_3} + \ldots$$

where p_1,p_2, p_3 denote the percentages of the component oxides, d_1, d_2, d_3 the densities to be attributed to them in the glass, and D the actual density of the glass.

The values of d assigned by Winkelmann and Schott to the oxides are given in Table I.

Table I.

SiO_2	2.3	BaO	7.0
B_2O_3	1.9	Na_2O	2.6
ZnO	5.9	K_2O	2.8
PbO	9.6	CaO	3.3
MgO	3.8	Al_2O_3	4.1

The investigators pointed out that the quantities d_1, d_2, d_3 are by no means identical with the densities of the separate oxides before combination, and that if the actual densities were used in place of the values given for d, they would give too small a value of D. They assumed that each oxide becomes denser by the act of combination, that is, there is a diminution of the total volume, and values termed "condensation" values were tabulated, BaO showing the largest increase (40 per cent.) and As_2O_5 the smallest (0.2 per cent.).

The factors given in Table I were employed by Winkelmann and Schott to calculate the density of 20 glasses, the difference between the values obtained and the actual values averaging 1.5 per cent., the greatest difference amounting to 4 per cent. Larger discrepancies occurred, however, when the factors were employed to calculate the densities of nine glasses appearing in an earlier paper by Winkelmann. An error exceeding 10 per cent. was obtained in the case of a zinc borate, while with a lead borate the error was of the order of 7 per cent.

A list of certain of these 29 glasses is given in Table II.

Peddle* attempted to calculate the densities of certain glasses by use of Winkelmann and Schott's factors, but owing to the considerable discrepancy between calculated and actual values, he concluded that the equation was of no use in calculating the densities of glasses containing an abnormal amount of any constituent oxide.

Some investigations upon the relation between the density of a glass and its composition were carried out by Tillotson.† From available data and from extensive experimental work, it was shown that closer agreement could be obtained between observed and calculated values if certain modifications were made in the factors given by Winkelmann.

Again, Baillie‡ adversely criticised Winkelmann's factors and by the application of revised factors claimed to obtain even better agreement than Tillotson had done. Consideration of the compositions given by Winkelmann in his list of 72 glasses, led to the conclusion that they were not based on analysis, since the sum of the constituent oxides always lay between 99.9 and 100.1 per cent. The fact that there were no traces of impurity normally found even in the most carefully prepared glasses was also taken as a significant indication that the results were obtained by re-calculation to the 100 per cent. basis. Proof that the results were calculated from the batch was subsequently found in a paper by Zschimmer§ which led Baillie to discard Winkelmann's data as totally inadequate to reproduce experimental results with any reasonable degree of accuracy.

It was at first decided to complete Tillotson's list of factors as the latter had not evaluated factors for either lead or potassium oxides, but it was found that if comparative results were to be obtained a distinctly lower value for combined SiO_2 was necessary. By selecting

Table II.

Glass No.	Composition Per Cent.								Density.		
	SiO_2	B_2O_3	ZnO	PbO	Al_2O_3	Na_2O	K_2O	CaO	Observed.	Calculated.	Difference %.
4	55.0	—	—	—	17.0	14.0	14.0	—	2.480	2.60	4.8
5	71.0	14.0	—	—	5.0	10.0	—	—	2.370	2.31	2.5
6	67.3	2.0	7.0	—	2.5	14.0	—	7.0	2.585	2.52	2.5
7	73.8	—	5.0	—	3.5	10.5	—	7.0	2.479	2.50	0.8
8	67.9	—	5.8	8.1	1.0	16.8	—	—	2.629	2.62	0.3
10	58.7	—	—	—	—	—	33.0	8.0	2.518	2.51	0.3
11	—	41.0	59.0	—	—	—	—	—	3.527	3.17	10.1
16	—	42.8	—	52.0	5.0	—	—	—	3.691	3.42	7.3
17	45.2	—	—	46.0	—	1.0	7.5	—	3.578	3.63	1.5
25	70.6	—	12.0	—	—	17.0	—	—	2.572	2.54	1.2
36	72.0	12.0	—	—	5.0	11.0	—	—	2.370	2.32	2.1

---

* J. Soc. Glass Tech., 1920, Vol. IV, 8.

† J. Ind. Eng. Chem., 1911, 3, 897 ; 1912, 4, 820.

‡ J. Soc. Chem. Ind., 1921, 40, 141.

§ Z. Electrochem, 1905, 11, 629.

three sets of melts of the Na_2O-BaO-SiO_2 series published by Tillotson, hree slightly different values for SiO_2 were obtained, and from these it was possible to calculate values for Na_2O and BaO. Similarly, by consideration of Larsen's data* for CaO-MgO-SiO_2 melts and by using the previously determined value for SiO_2, the factors for CaO and MgO were evaluated.

A new list of factors was arranged on this basis and is shown below in Table III, together with densities of the respective oxides in the free state and the values proposed by Tillotson.

Table III.

Oxide.	Density in Free State.		Density in Combined State.	
	Determined.	Remarks.	Tillotson.	Baillie.
SiO_2	2.22	Deville 1855	2.3	2.24
Al_2O_3	3.85	Rammelsburg	2.75	2.75
Sb_2O_4	6.69	—	—	3.00
B_2O_3	1.79	Clarke	2.24	2.90
As_2O_3	3.74	—	4.1	3.33
ZnO	5.65	Schroder	5.9	5.94
BaO	5.00	Clarke	7.0	7.20
CaO	3.30	Moissan	4.1	4.30
MgO	3.60	Clarke & Moissan	4.0	3.25
PbO	9.30	Clarke	9.6	10.30
K_2O	2.66	—	2.8	3.20
Na_2O	2.55	—	2.8	3.20

In the absence of alkali oxides the value for MgO is taken as 4.2. As the basis of calculation, Baillie proposed to adopt instead of Winkelmann and Schott's well-known formula, the modification

$$\frac{A}{D} = \frac{p_1}{d_1} + \frac{p_2}{d_2} + \frac{p_3}{d_3} + \dots$$

where A is the sum of the oxides determined by chemical analysis. The errors obtained in using Baillie's factors and those resulting from the factors of both Tillotson and Winkelmann are summarised in Table IV.

Table IV.

	Winkelmann.	Tillotson.	Baillie.
Arithmetical Mean of Errors	0.058	0.029	0.018
Mean Square Error ...	0.071	0.041	0.026
Algebraical Sum of Errors	4.109	0.729	0.118

English and Turner have carried out extensive investigations† upon several series of glasses of the tri-silicate type having the general formula $6SiO_2$, xRO, yNa_2O (where $x+y=2$). In the first series, lime replaced soda, bringing about a rise in density. The results are shown in Fig. 2, where the densities have been plotted against molecular percentage composition.

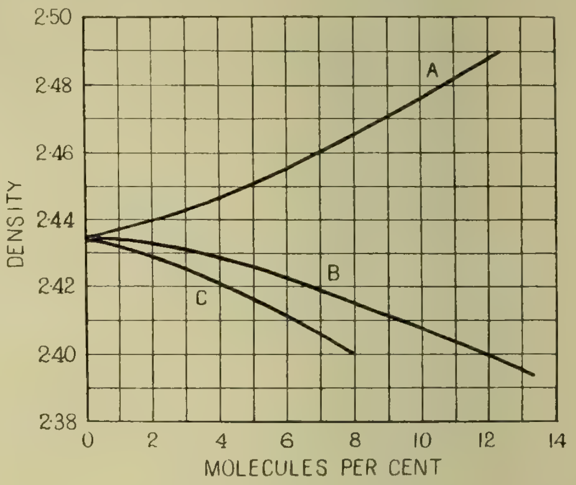


Fig. 2.

It will be observed that apart from a slight curvature at the initial extreme, the Curve A is practically a straight line, indicating that the relationship between density and chemical composition is almost a linear one. The same result is obtained when magnesia replaces soda, Curve B, except that the density diminishes instead of increasing as was the case when lime replaced soda.

In the case of Curve C, it is found that the replacement of soda by alumina results in a considerable decrease in the density, the decrease being somewhat greater than with the magnesia glasses of the same molecular type. The same initial curvature is found as with the calcium and magnesia series.

The investigators attempted to use Winkelmann and Schott's factors to calculate the density of the glasses in the series examined, but discarded them as useless. They pointed out that since the factor given for magnesia is greater than that for soda (Table I) the continuous replacement of soda by magnesia would bring about an increase in density and, as is shown in Fig. 2, precisely the opposite result was obtained by experiment. Peddle* commented upon this and confirmed that when soda is replaced molecularly by magnesia there is a decrease in density, and also that when the results are plotted in terms of molecules per cent. of MgO, a straight line is obtained. The series of glasses investigated by Peedle were of the type $5SiO_2$, xNa_2O, $yMgO$, the results obtained being shown in Table V.

It was pointed out by the same writer, however, that the decrease in density when magnesia replaces soda molecularly is only true where the silica remains constant molecularly, and that it is possible to have a continuous increase in density with an increase of magnesia. Two series of glasses were quoted in order to illustrate the point, namely :—

(1) $100SiO_2$, $40Na_2O$, $xMgO$
(2) $100SiO_2$, $20Na_2O$, $xMgO$

---

* Amer. J. Sci., 1909, 28, 163.

† J. Soc. Glass Tech., 1920, IV, 127, 153; 1921, V, 277; 1922, VI, 228; 1923, VII, 160.

* J. Soc. Glass Tech., 1920, IV, 282.

where the molecular silica-soda contact remained constant, while the magnesia content rose from 5 to 40 molecules. In the latter series the density rose from 2.38 to 2.48 (approximately). In the corresponding lime series, the increase was much greater, the density rising from 2.41 to 2.66 (approximately). Peddle summarised his results as follows :—

Table V.

ss.	Molecules.			Density.
	SiO_2.	Na_2O.	MgO.	
A	5	1.75	0.25	2.453
B	5	1.625	0.375	2.448
C	5	1.50	0.50	2.444
D	5	1.375	0.625	2.439
E	5	1.25	0.75	2.433
F	5	1.00	1.00	2.421

(a) In glasses where the molecular SiO_2 and Na_2O content remains constant, increasing the molecular content of either MgO or CaO raises the density.

(b) Comparing either the two MgO series or the two CaO series where the SiO_2, MgO or SiO_2, CaO content is the same in two glasses, the one with the higher molecular Na_2O content will have the higher density.

(c) The rate of increase of density per molecule of CaO added is much greater than the rate of increase per molecule of MgO added.

(d) The rate of increase of density diminishes in both the MgO and CaO glasses as the amount of magnesia or lime increases, and this diminution is most marked in the series containing the most Na_2O.

(e) In two like series of CaO and MgO glasses, the lime glasses have a higher density than the magnesia glasses.

Baillie's factors (Table III) had not been determined at the time English and Turner commenced their investigations and an attempt was made by them to deduce a new set of factors. It was assumed that silica, in combination with silicates, has the same density as in the pure fused state, in which case the value would be 2.206 (Chappuis). The remaining factors were deduced by the method described by the investigators for the calculation of the thermal expansion factors.* The final values adopted are as shown in Table VI.

Table VI.

SiO_2	2.20
Na_2O	3.47
CaO	5.00
MgO	3.38
Al_2O_3	2.75

Applied to the soda-lime alumina and soda-lime magnesia series of glasses investigated by English and Turner, very close agreement is obtained between calculated and actual values. A summary of the results is given in Table VII, together with the results obtained by using factors deduced by other investigators.

By comparing the results obtained by application of the respective sets of factors it will be seen that, while a close agreement is obtained with those of English and Turner, and also with those of Baillie, there is a considerable divergence from the actual density values when Tillotson's factors are used, especially in the series of soda-lime-magnesia glasses from Nos. 9 to 331. As will be seen from Table III, Tillotson assigned almost identical values to lime and magnesia so that it can scarcely be expected that any considerable difference will occur in the calculated densities when these two oxides replace one another and the other constituents remain in fairly constant proportion. There is less to choose between the results of English and Turner and those of Baillie, the latter's perhaps being slightly inferior.

Table VII.

Glass.	Composition Per Cent.					Density.			
	SiO_2	CaO	MgO	Na_2O	Al_2O_3	A.	B.	C.	D.
9	74.96	9.36	0.28	14.88	0.42	2.4757	2.470	2.465	2.474
490	74.76	7.52	1.64	14.84	0.93	2.4637	2.464	2.476	2.476
491	74.74	6.43	2.58	14.98	1.02	2.4569	2.456	2.473	2.473
492	75.58	5.48	3.66	14.48	0.87	2.4496	2.437	2.460	2.463
493	76.32	3.82	4.10	14.58	0.87	2.4364	2.426	2.444	2.460
494	76.00	3.14	4.85	14.98	0.90	2.4265	2.423	2.445	2.457
331	76.68	0.14	6.87	15.78	0.42	2.4055	2.414	2.415	2.474
458	73.98	7.10	—	11.66	7.10	2.4421	2.439	2.443	2.460
459	74.25	7.91	—	12.72	5.23	2.4498	2.443	2.444	2.460
460	74.13	9.74	—	13.54	2.67	2.4655	2.465	2.461	2.475
10	74.59	10.38	—	14.22	0.45	2.4840	2.478	2.469	2.488

A. Actual values.
B. English and Turner.
C. Baillie.
D. Tillotson.

Although it is hardly to be expected that a closer agreement could be obtained between actual and calculated values, certain departures are observed from the formula that the density is a linear function of the percentages of the constituent oxides, which seem to indicate that the additive relation is to some extent modified according to the constitution of the glass. That the density is indeed to some extent a constitutive property was pointed out by Peddle in his investigations* upon the development of various types of glass. An example of this is given in the two series of glasses of the general formula $100SiO_2$, $20K_2O$, xPbO and $100SiO_2$, $40K_2O$, xPbO. The conclusion drawn from the results are that (a) the density values increase as the molecular PbO content increases, (b) the rate of increase in density per molecule of PbO added decreases as the PbO content rises, and (c) the rate of increase in density is greater in the series containing the less K_2O.

---

* J. Soc. Glass Tech., 1920, IV, 118.

Somewhat different is the case of boric oxide-containing glasses. It has already been mentioned that large discrepancies occurred between actual and calculated values when Winkelmann and Schott's factors were used to calculate the densities of certain boric oxide glasses. That this was not entirely due to the injudicious choice of factors is made evident in the light of comparatively recent investigations† upon this type of glass. Determinations were made of the densities of two series of glasses with 10 per cent. and 20 per cent. Na_2O respectively and varying proportions of B_2O_3. The series with 20 per cent. Na_2O will be used to illustrate the effect of boric oxide upon the density, the approximate composition being given in Table VIII, together with the density as determined by the method explained earlier in this article.

Table VIII.

Glass.	Composition Per Cent.					Density.
	SiO_2	Al_2O_3	Na_2O	CaO	B_2O_3	
A	79.84	0.69	19.46	0.12	—	2.3748
B	74.22	0.93	19.78	0.14	4.46	2.4291
C	71.56	1.00	18.76	0.10	8.28	2.4710
D	68.39	1.01	18.92	0.12	11.34	2.4919
E	64.72	0.72	19.95	0.14	14.45	2.5055
F	61.28	0.74	18.93	0.11	18.84	2.5126
G	50.04	0.78	20.36	0.08	28.83	2.4890
H	35.22	0.84	23.71	0.16	39.99	2.4526
I	32.23	0.84	23.08	0.22	43.70	2.4262

The density is found to rise to a maximum at 18.84 per cent. B_2O_3, and then to fall off considerably. The occurrence of a maximum point in the density is somewhat unique in character, being observed only with this type of glass, but the density is by no means the only property in which it occurs. Maxima are also noted in the case of the refractive index and annealing temperature, while a minimum occurs in the co-efficient of expansion.

The maximum density point is exemplified better in graphical form in Fig. 3.

It is quite obvious that the density factors assigned to boric oxide by the various investigators are useless when an attempt is made to calculate the densities of glasses of this type. The calculated densities will rise continuously and are therefore comparative with the actual values only over a very limited range.

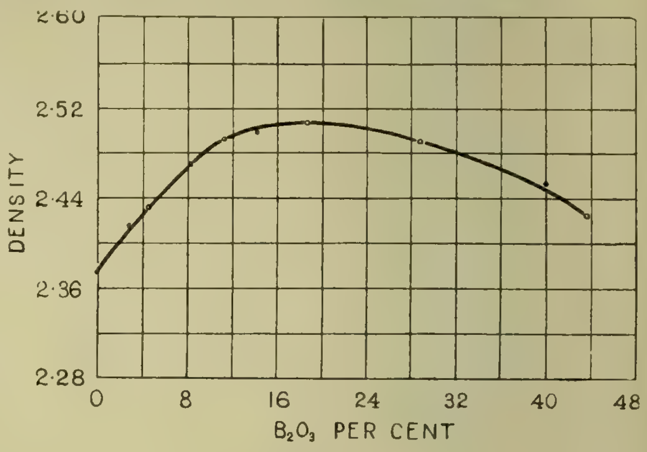
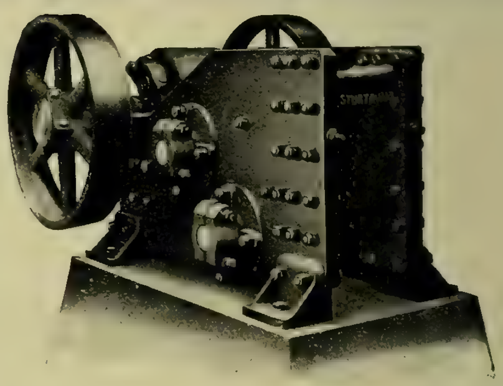


Fig. 3.

It should be borne in mind by those who have occasion to determine the density of a glass by calculation that the factors assigned to the oxides have been obtained for the most part empirically and with an inadequate knowledge of the constitution of glass. Until further research has disclosed the exact relation between the properties of glass and its chemical constitution, any but experimental determinations should be avoided.


For Breaking down
Glass Cullet

the Sturtevant Roll Jaw Fine Crusher is the ideal machine. It can be adjusted to give a coarse or fine product, and the mechanism ensures smooth running, slow speed, and the minimum of power
Write for free leaflet G.L. 1541.

STURTEVANT
ENGINEERING
Co. LTD.
149 QUEEN VICTORIA ST LONDON E.C.4.

---

* J. Soc. Glass Tech., 1920-21.

† English and Turner, J., Soc. Glass Tech., 1923, VII, 160

Glass Etching by Hydroflouric Acid.

Minute Observations.

By JAMES SCOTT, M.S.C.I., M.A.C.S., M.E.H.A.

Of the two methods practically and extensively adopted for the etching of glass, namely, by means of sandblasts, and hydrofluoric acid, respectively, that followed in the second process is by far the most interesting. As it is worth minute and chemical observation, I propose to go fully into its various features.

Hydrofluoric acid is, I believe, the only agent which is *obviously* destructive to glass. Although there are many substances which *gradually* decompose it after being in direct contact with it for prolonged periods, hydrofluoric acid stands essentially alone in acting within a few moments.

There is a mineral known synonymously as fluor-spar, calcium fluoride, and calcium fluate. It is found in various colours—grey, white, blue, green, yellow, purple, black, etc.—and in conditions which are earthy, nodular, lamellar, or crystallised as cubes, octahedra, rhomboids, and dodecahedra, the best being transparent white. Upon powdering a quantity of this compound, placing it in a leaden or platinum basin, or similarly suitable receptacle, and then pouring over it a proportional amount of strong sulphuric acid, it is caused to yield a suffocating vapour-laden gas known as hydrofluoric acid. This is so injurious to the eyes, especially, that the greatest care has to be exercised when working with it, either industrially or experimentally. The fluid will cause malignant skin ulcers.

It is really analogous with hydrochloric acid, and like that product possesses an affinity for water, forming with it the ordinary commercial fluid.

The best proportions of the two materials necessary for its production are :—

Calcium fluoride	.. ..	$\frac{1}{4}$ ounce
Sulphuric acid	.. ..	$\frac{1}{2}$,,

A gentle heat is required beneath the container in order to force the mixture to yield its full proportion of acid.

The gaseous element, fluorine, which has never been *purely* isolated, undoubtedly resembles hydrochloric acid gas, and discloses similar properties; the silicates, especially, are liable to violent decomposition by its means, more particularly when a certain percentage of water is combined with it (as is the case with the industrial acid), so that its activities are concentrated and capable of being easily manipulated. Glass being a mixture of various silicates according to whether soda, lime, etc., are used in its composition, the glaze of earthenware, and to a lesser degree the aluminium-silicate (i.e. clay) body, of the same goods, are all amenable to the corrosive influences of hydrofluoric acid, which is a clear white liquid as bought.

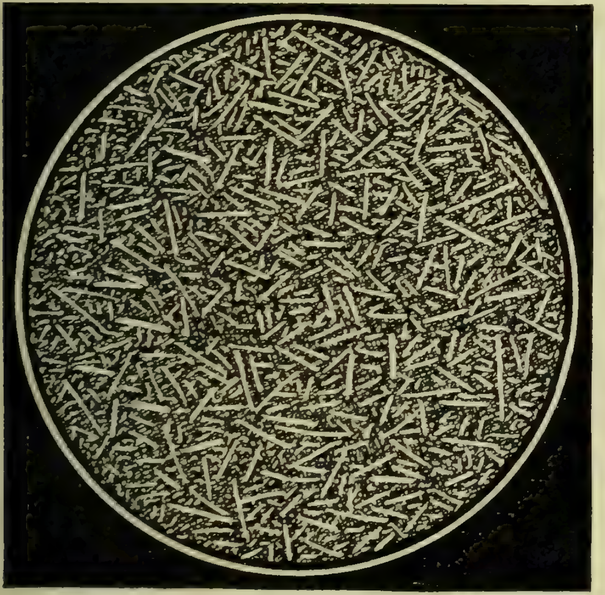


Fig. 1.
Glass sheet etched by vapour fumes of hydrofluoric acid for a few moments.

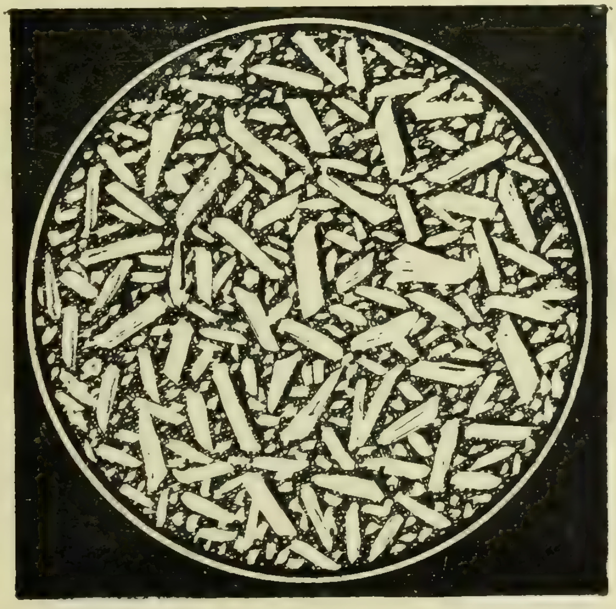


Fig. 2.
Glass sheet etched for a few moments by solution of hydrofluoric acid. Rhombic crystals in a stippled ground work. Permanent.

It is customary, when etching small panes of glass, glass bottles, and other articles made of glass, to cover the substance with a thin film of melted paraffin wax, either by first warming the glass and then rubbing the solid, or frozen, wax over its surface, pouring the melted wax thereupon, or dipping them momentarily into a solution of melted wax.

For the larger kinds of etching, stencils—consisting of designs, lettering, and other figurings, as required—of paper, foil, and so on, are first temporarily stuck upon the surfaces of the materials to be etched. Subsequent to the application of the paraffin wax layer upon the goods, and its cooling and solidification, the stencils are peeled off carefully, thereby exposing certain naked areas for the acid. For the finest work, however, a uniformly cooled film of paraffin wax is skilfully engraved with the desired lettering or design.

Whatever may be the selected preparatory treatment, it must be noted that etching of the bared glass can be undertaken either by exposing it to the fumes of hydrofluoric acid, or an aqueous solution of the same product. If the glass is suspended over a vessel containing the latter form of the substance, the rising vapour will attack it immediately, and not simultaneously cause any dislodgement of siliceous particles. On the other hand in the event of the aqueous acid being allowed to come into contact with the glass, a definite proportion of the silicates are dissolved out of it by this exceptionally corrosive material.

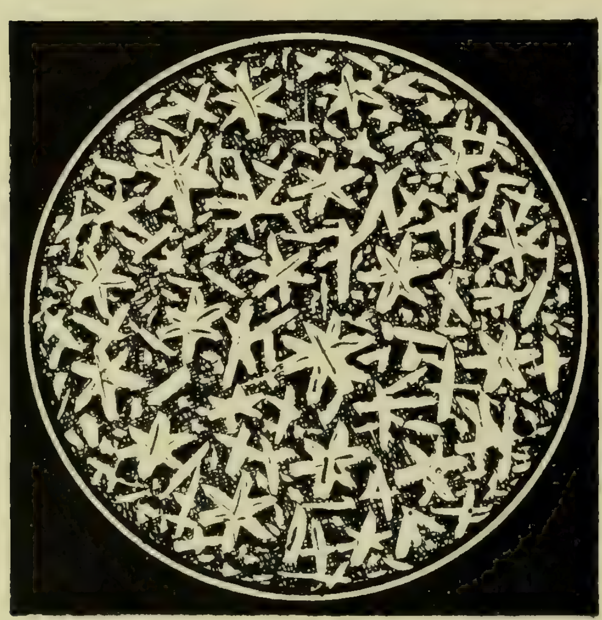


Fig. 3.
Glass sheet etched several minutes by solution of hydrofluoric acid.

A method has been in vogue for some years, in which the use of paper or other stencils is involved, the same having been so prepared with hydrofluoric acid that when the stencil is moistened in water, and then spread upon glass, its action is engendered in the usual way, and etching follows.

Some very beautiful permanent results can be obtained by manipulating silica-glass, or any other variety of the substance—with hydrofluoric acid in suitable apparatus, thereby producing hydrofluo silicic acid, which is at first gelatinous, but finally becomes solid.

Bones, both human and other calcic kinds, contain a definite proportion of calcium fluoride in their composition. The same substance—fluorine in combination—also occurs in many plants and other organic growths; and it is quite probable that a great deal of the *progressive* destruction of glass—extending, maybe, over very long periods, e.g. bottles containing certain liquids, etc.—is occasioned by the slow susceptibility of its particles to the action of dilute hydrofluoric acid evolved therein by the chemical reactions of various contents; the glass, in some places, first becoming minutely granular, and finally crystalline, with the capacity, or fault, of chipping away from the main homogeneous mass. This idea is, of course, quite speculative, but is put forward after several years' close study of glass and glazed objects.

Coming to a consideration of the microscopical aspect of the subject, I wish to say that anyone who will take the trouble to gather together a number of pieces of etched glass—from panes of screens, windows, lamps, etc., and spirit and other bottles—would eventually become possessed of a collection of very pretty, endurable, minute spectacles.

Viewed from a practical standpoint such an accumulation would possess great attraction, because it would enable the owner to more completely understand the real action of hydrofluoric acid upon glass than can, perhaps, be obtained by ordinary examination, unassisted by the use of magnifying instruments.

I have learnt, by close observation of the effects of hydrofluoric acid on glass, that the *finest* results occur when the surface is exposed for a few minutes to the action of the fumes discharged from the liquid variety of the acid. The higher the glass is above the source of gas, the shallower are the results, the minute figurings being more closely set together, and the general appearance of the whole (*to the naked eye*) having a better, smoother, frost-like, opaque appearance. A reproduction of one phase of this development is shown in Fig. 1; but it should be borne in mind that the reader could find numerous diversions therefrom.

If, instead of the fumes alone being permitted to act on the glass, the common liquid hydrofluoric acid comes into contact with it, very bold crystalline figures will stand up in neat, pretty relief on the surface, these being quite intact and permanent. An example is depicted in Fig. 2.

By giving the glass a longer experience of mutual operation with the hydrofluoric acid many of the crystals will flake off, owing to the acid eating its way *underneath* them as they are produced by its own action; and then the effect becomes still more complicated, because, in this case, we have not only upstanding, fixed crystals, but depressions due to the consumption, or removal, of several of the glass particles thus isolated. Fig. 3 shows this result.

The results just illustrated are in marked contradiction to those obtained by the use of the sand-blast; in this case, no trace of crystalline configuration will be found, but merely irregular mechanical pitting and ridging of the surface.

The Annealing of Glass.

A Non-Technical Presentation.[*]

By A. N. FINN.

Introduction.

The rapid reduction in the temperature of glass which is incident to practically all commercial moulding almost invariably produces a condition in the glass commonly known as "strain."[†] This condition must, in general, be removed before the ware is satisfactory for commercial purposes, and its removal is called annealing or tempering.[‡]

Strain is due to an inelastic yielding under the stresses developed within the body of the glass while cooling, because at any moment during this time the different parts of the body are not contracting at the same rate. During moulding the surface of the hot glass coming in contact with the relatively cold mould shrinks or contracts very rapidly and is quickly cooled to a temperature at which the glass is rigid. The interior loses its heat more slowly and, consequently, contracts less rapidly than the surface, which must, therefore, if the stresses become large enough, either crack or yield inelastically.

After the surface becomes rigid or at least practically so, it does not yield readily to any force applied to it and tends to resist the contraction of the hotter and relatively soft interior as it continues to cool and contract. This produces stresses in the glass, the surface usually being compressed while the interior is dilated. If these stresses exceed the strength of the glass, it will break. This may occur either during the initial cooling or subsequently whenever the glass is subjected to sudden temperature changes, such as those resulting from the action of hot or cold water. In order to reduce the liability of breakage of ordinary ware to a minimum, glass must be annealed.

The annealing of glass consists of two fundamental steps. The first is to heat it to such a temperature that the entire body of the glass becomes sufficiently soft to permit it to yield. Then, if sufficient time be allowed, the stresses developed during moulding will disappear. The second is to cool it so slowly that the temperature differences between the interior of the glass and its surfaces, with the consequent differences in contraction, are not great enough to produce objectionable strain.

The Annealing Range.

In order to anneal glass most successfully, it is necessary to know the temperature range in which it can be done. At too high a temperature the glass will soften so much that it will lose its shape. If the temperature is too low, either an excessive amount of time will be required or the glass will not be annealed.

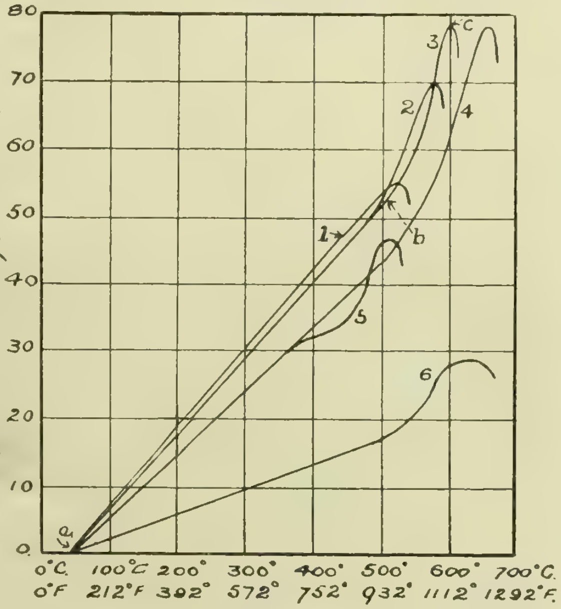


Fig. 1.

Thermal expansion curves of six glasses.
See Table I for compositions.

Several methods have been recommended for determining the annealing temperature for a glass. Among them the "cut and try" method, the bending rod method,[*] the method of observing the glass in polarised light during heating,[†] the location of the region of abnormal heat absorption,[‡] and the measurement of the variation of the expansivity with temperature[§] may be mentioned.

Of these the last two seem, in general, to be most satisfactory. The heat absorption method not only locates the annealing range but also gives an idea as to how the particular sample was annealed. The thermal expansion method gives, in addition to the annealing range, definite information regarding the thermal expansion of the glass.

Figure 1 is taken from data obtained at the Bureau

---

[*] Published by permission of the Director, Bureau of Standards, and the American Ceramic Society. Presented at the Annual Meeting, American Ceramic Society, Atlanta, Ga., Feb., 1926. (Glass Division.)

[†] This is permanent strain and should not be confused with temporary strain resulting from the application of external force or temperature differences.

[‡] Tempering sometimes means the intentional introduction of strain, as, *e.g.*, in the heat treatment of glass to produce special physical properties.

[*] English and Turner, *Jour. Soc. Glass Tech.*, 2, 90 (1918).

[†] Tool and Valasek, Bur. Stand., *Sci. Paper*, No. 358 (1920); Adams and Williamson, *Jour. Frank. Inst.*, 190, 597—631; 835—70 (1920).

[‡] Tool and Eichlin, *Jour. Amer. Ceram. Soc.*, 8, 1—17 (1925); *Jour. Op. Soc. of Am. and Rev. Sci. Inst.*, 8, 419—49 (1924).

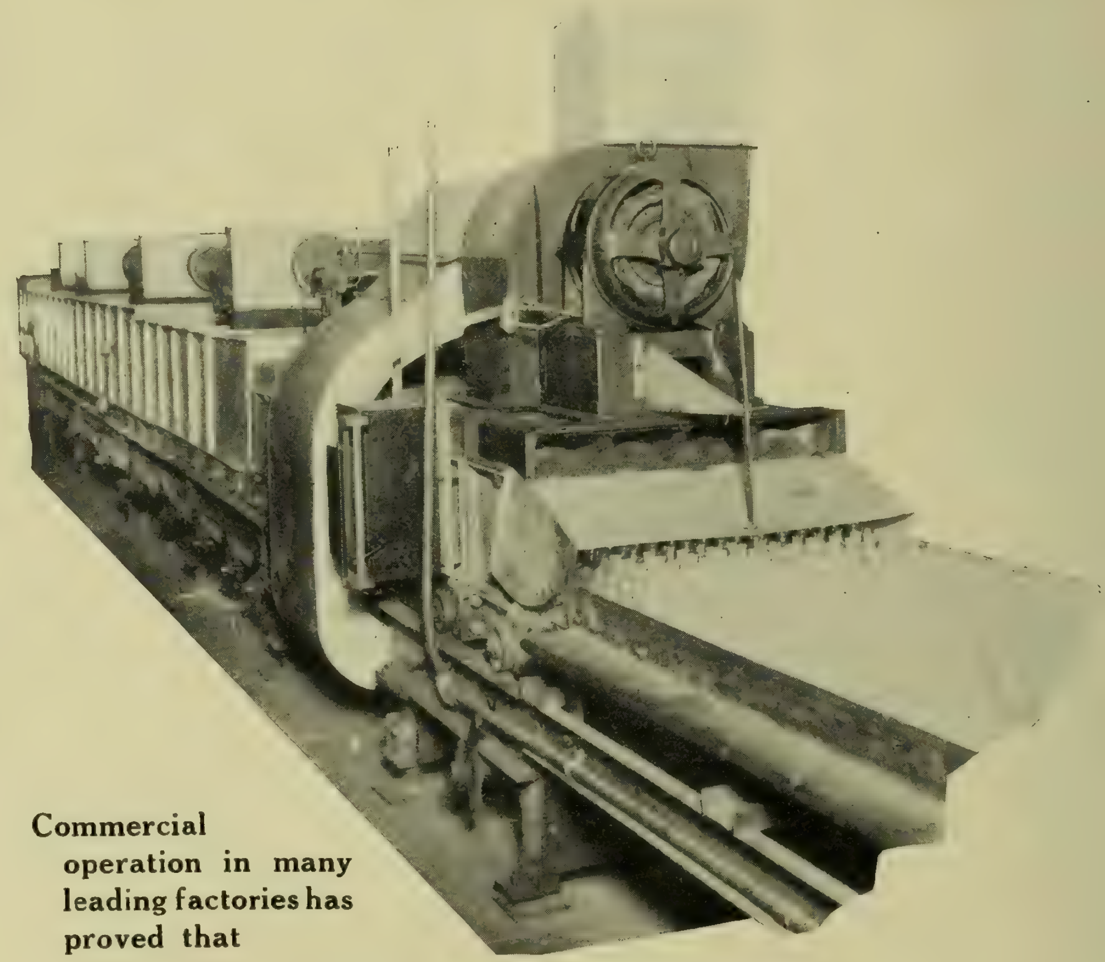
[§] Peters and Cragoe, Bur. Stand., *Sci. Paper*, No. 393 (1920).

Another Scientific Development

THE HARTFORD LEHR

IS CREATING

A NEW STANDARD OF ANNEALING



Commercial operation in many leading factories has proved that

THE HARTFORD LEHR

1. Gives **"GRADE A" ANNEALING AT ALL TIMES.**
2. Saves FUEL (as high as 85% saving has been shown).
3. „ WARE (No "Lehr Loss").
4. „ LABOUR.
5. „ SPACE.
6. „ UPKEEP EXPENSE.

The British Hartford-Fairmont Syndicate Ltd.

142 - 143 Audrey House, Ely Place, London, E.C.1.

"HARTFORD" AUTOMATIC FEEDERS - FORMING MACHINES - LEHRS

of Standards* and shows the thermal expansion curves of several commercial glasses whose approximate compositions are given in Table I.

It will be noted that all the curves are similar except No. 1. This similarity consists of a fairly straight line from a to b (indicating a uniform expansion in that temperature range), an abrupt change at b (indicating an increased rate of expansion) and a reversal of direction at c (indicating a material softening of the glass).

Table I.

Approximate Percentage Composition of Glasses Nos. 1—6.

	SiO_2	CaO	MgO	Na_2O	Al_2O_3	B_2O_3
1 ..	74	5	3	17	1	—
2* ..	74	6	3	17	—	—
3 ..	72	11	—	17	—	—
4 ..	72	15	1	12	—	—
5 ..	Lead Tubing					
6 ..	81	—	—	5	2	12

*Computed from batch composition.

The ordinary commercial annealing range of any of these glasses (except No. 1) is between the points b and c. However, since the "yield" or "flow" of the glass at b is very slow, it would take at least several hours to anneal it at this temperature. At c the "yield" is usually very rapid and the stresses or "strain" in the glass will be dissipated almost as soon as the glass reaches this point.

Curve 1 does not show an increase in the rate of expansion comparable with the section b c of the curves for the other glasses, since the available data show that the rate of expansion of this glass is practically uniform from room temperature to its softening point. From such a curve it is impossible to determine the whole range in which the glass could be annealed, but it does locate a very narrow range (about 512° C., 954° F.) near an apparent softening point. The use of this narrow range would require very accurate temperature control in order to anneal the glass without danger of overheating it. Preliminary thermal absorption measurements on the same glass indicate that the annealing range is between 500° C. and 530° C. (932° F. and 986° F.), which gives greater latitude in controlling lehr temperatures. Although it was reported that this glass could not be annealed satisfactorily, this was successfully accomplished in the first trial at the Bureau of Standards by holding it at 512° C. (954° F.) (as indicated by the curve) for 20 minutes before cooling slowly.

Figure 2 shows the heat absorption curves obtained from three portions of a piece of window glass.† These curves have two points in common, one at about 500° C. (932 ° F.) where heat absorption begins and one at about 610° C. (1130° F.) where this absorption ceases. The temperature range in which heat is absorbed is regarded as the annealing range and is comparable with the range b c of curve 3 in Fig. 1. The vertical displacement of the curves in Fig. 2 is associated with the degree of annealing of the respective samples, the upper curve being obtained with a highly strained sample and the lower one from a well annealed sample.

The Annealing Temperature and Time.

Although stresses in glass are released very quickly at the maximum temperature of the annealing range, it does not follow that this temperature will be best suited for expeditious work.

Very thin ware can with safety be cooled rapidly from the maximum temperature, but the safe cooling rate decreases very rapidly as the thickness increases. Although the time required for annealing at lower temperatures is somewhat greater, it has been shown* that the use of lower annealing temperatures permits a more rapid cooling rate which more than compensates for the increased time for annealing.

The selection of the annealing temperature should then be governed by the thickness of the ware. An ordinary soda-lime glass which begins to soften at approximately 600° C. (1110° F.) can be annealed in about 30 minutes at 535° C. (995° F.), in two hours at 515° C. (960° F.), and in 10 hours at 490° C. (914° F.). These approximate the most satisfactory temperatures to use for ware whose thickness is 1, 2 or 5 cm.

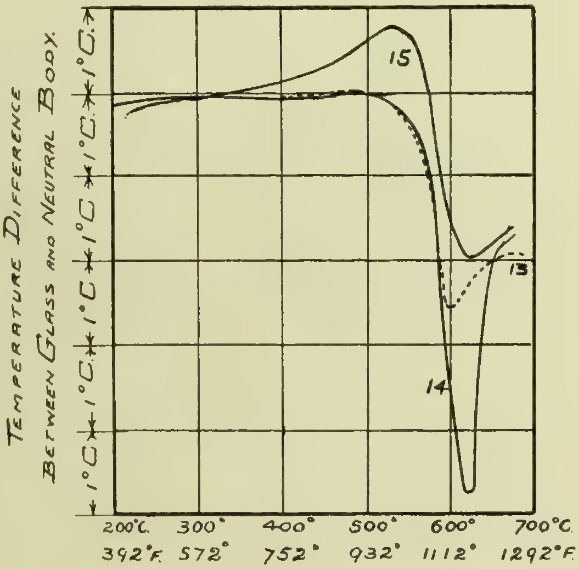


Fig. 2.

Heat absorption curves of a specimen of window glass. Curve No. 13, the original glass; No. 14 after annealing at 515°C; No. 15 after rapid cooling from 670°C.

The Cooling Rate.

The cooling rate depends not only on the temperature from which the glass is cooled (the annealing temperature) but also on its thickness. Using the annealing temperatures mentioned above, the initial cooling rate for glass 1 cm. thick is about 100° C. (180° F.) per hour, for glass 2 cm. thick, 25° C. (45° F.) per hour and for glass 5 cm. thick 4° C. (7° F.) per hour. But as the temperature falls, this rate can be increased, so that after the temperature has dropped about 35° C. (63° F.), it may become twice as great, i.e. 200° C. (360° F.), 50° C. (90° F.), and 8° C. (14° F.) per hour and finally after a drop of 100° C. (180° F.), the rate per hour may

---

* Peters and Cragoe, Bur. Stand, Sci Paper No. 393 (1920).

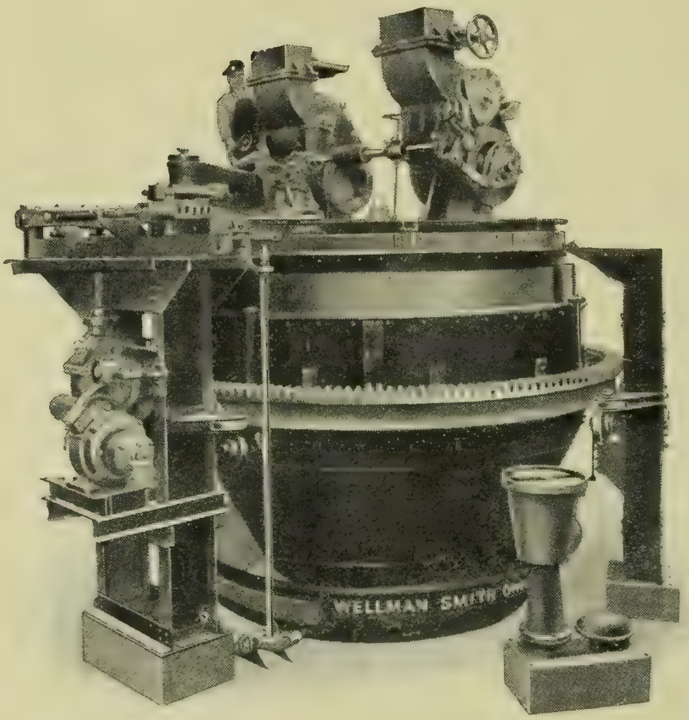
† Tool and Eichlin, *loc. cit.*

* Adams and Williamson, *loc. cit.*

WELLMAN GAS MACHINES

INCREASE OUTPUT

BY INSTALLING WELLMAN TYPE "L" GAS PRODUCERS.



Automatic from coal feed to ash delivery.

Oscillating Poker ensures constant rich gas at all outputs.

Intermittent ash pan motion prevents clinker bridging.

Lowest labour and running cost of any producer.

The result of twenty years' continuous experience in the manufacture and running of over 1,300 Gas Producers.

Every Glassworks Manager and Engineer should send for our handbook on Gas Making.

THE WELLMAN SMITH OWEN ENG. CORP., LTD.

36-38, KINGSWAY, LONDON, W.C.2.
WORKS :: :: DARLASTON, SOUTH STAFFS.

Telephones: HOLBORN 2588 & 2589. *Telegrams:* "PRINCIPIUM, WESTCENT, LONDON."

be as high as 1500° C. (2700° F.), 400° C. (720° F.), and 60° C. (108° F.) respectively.

After this glass has been cooled below about 400° C. (752° F.) the rate may be increased still more without danger of introducing permanent strain unless the temporary strain developed exceeds the strength of the glass and breaks it.

Temperature Control.

The foregoing statements are based on the assumption that temperatures can be accurately controlled, a condition which is hard to obtain in many of the commercial lehrs in use. However, it is suggested that properly installed base-metal (chromel-alumel) thermocouples, connected with a suitable temperature indicator will help to improve and control the quality of annealing obtained in any plant.

Needless to say, the greater the uniformity in the temperature of any zone in the lehr both from side to side and from top to bottom, the better the grade of the annealing will be.

Apparatus for Detecting and Estimating Strain.

Strain in glass is easily detected by means of polarized light, but since this is not a technical paper, any attempt to discuss polarized light would be out of place. However, a discussion of the fundamental principles of a strain detector, scleroscope, or polariscope is not out of place. Regardless of the names these instruments may have, they all involve the same principle.

A beam of light (white light) is either reflected from or passed through a " polarizer " which in the first case is usually a plate of black glass or, in the second, a number (pile) of thin transparent plates and in both cases the surfaces of these plates must make a definite angle with the beam. The reflected or transmitted beam then passes through the sample being tested and is again reflected at the same angle as before from another plate of black glass or is passed through a second pile of plates set at the proper angle. In either case these are called the " analyzer," and they are sometimes replaced by a nicol prism. From the character of the light finally passing the analyzer the degree of annealing is determined. If the sample is free from strain, no change in the intensity of the field (as compared with the field when no sample is used) or in the appearance of the sample will be observed ; if it is moderately strained, the light will be brighter in certain areas ; and if it is highly strained, it will appear coloured, and the colour will vary over the field of view.

If the analyzer is a nicol prism, a sensitive tint plate may be advantageously used, because this, in a way, intensifies the effects obtained with moderately strained glass by producing a series of colours which can be more easily interpreted and compared with those obtained in testing other (standard) samples.

The apparatus used at the Bureau of Standards for determining the " amount of strain " or the degree of annealing is so simple in construction and yet so eminently satisfactory, that a detailed description of it will be given. (See Fig. 3.)

Source of Light.

A 200-watt electric light bulb is enclosed in a box made of bright sheet metal. A ½-inch hole is cut in one side of the box and covered with a piece of glass whose surface is " fine " ground. This small piece of glass, illuminated by the lamp, is the actual source of light.

A condensing lens, 7 inches in diameter, and having a 15-inch focal length, is so placed that its focus is at the " source of light." The light after passing through the lens is practically a parallel beam, but not entirely so since the source is not a " point."

Polarizer.

The beam of light then strikes a piece of polished black glass at an angle of approximately 33° (between the beam of light and the glass) or the angle which is necessary with the particular glass for obtaining the best polarization possible*. Although the beam of light reflected from the black glass is apparently not affected, it is, nevertheless, polarized.

Analyzer.

At some distance in front of the black glass polarizer a nicol prism is placed in the polarized beam, so that the enlarged image of the " source " is visible through it. By turning the nicol the intensity of the light will change progressively from bright to dark. The nicol is properly set when the field is as dark as possible.

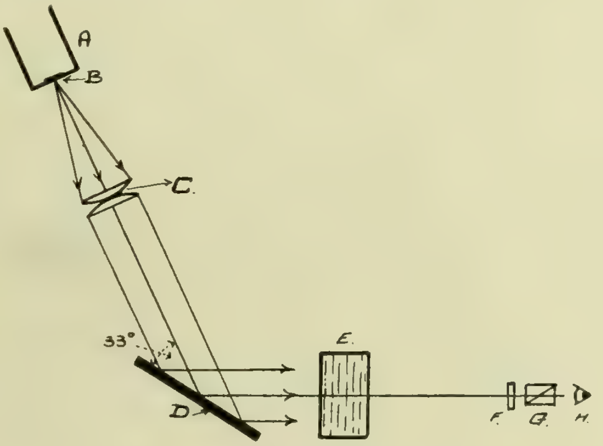


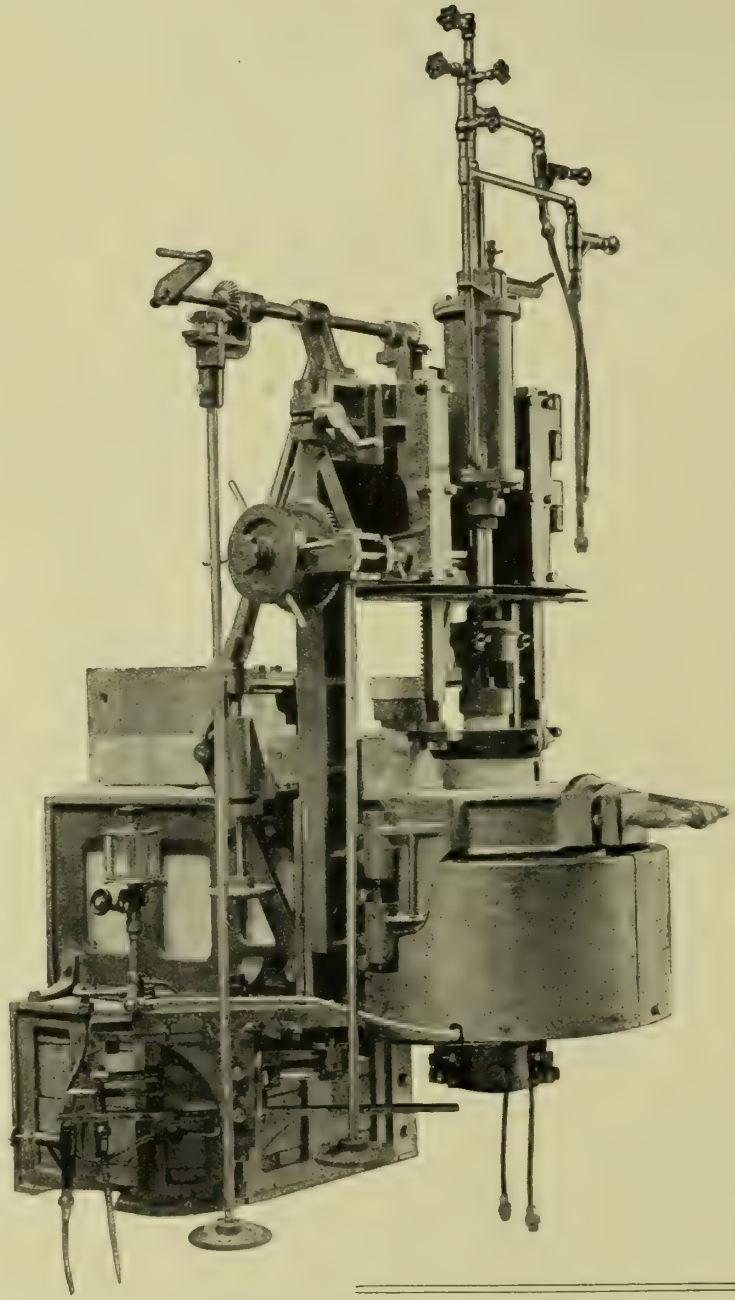
Fig. 3.
Sectional view of polariscope for testing glass for strain. *A*, source of illumination ; *B*, ground glass ; *C*, condensing lens ; *D*, black glass plate (polarizer) ; *E*, sample to be tested ; *F*, sensitive plate ; *G*, nicol prism (analyzer) ; *H*, observer's eye.

Tint Plate.

The tint plate, which should be a " First Order Purple " (retardation, about 575 $\mu\mu$), is mounted directly in front of the nicol prism and is set by turning it until the colour of the light passing through the prism is as marked as possible. Nicol prisms and tint plates can be obtained from practically any dealer in optical instruments.

---

* An angle of 33° can easily be obtained as follows : Draw a right triangle with one side 15¼ inches and the other side 10.0 inches long. The angle between the long side and the hypotenuse will be about 33°.



The "RANKIN" Automatic Glass Feeder.

RESULTS JUSTIFY CLAIMS.

Claims without justification are futile.

The need for automatic production is admitted by every glass manufacturer. The question is—what mechanism can be installed with the assurance of the best results?

The "RANKIN" record is unrivalled in the Glass Feeder world. Its history is unique. In no instance has a "RANKIN" installation once installed been superseded. On the contrary, wherever it has been adopted, further installations have followed.

The latest proof of this claim is a repeat order for **TWELVE FEEDERS** from a Glass Manufacturing Company, who originally put in one Feeder for comparison with other similar devices. This we believe to be

THE LARGEST INDIVIDUAL ORDER EVER PLACED FOR AUTOMATIC FEEDERS

and represents a great triumph for an All-British Built Feeder.

The mechanism, material and finish are of the highest possible quality. The "RANKIN" Feeder is built for service and will outlast all others.

Demonstrations of the RANKIN AUTOMATIC GLASS FEEDER will be arranged by appointment.

For Illustrations, Descriptive details and terms apply to :

THE RANKIN AUTOMATIC GLASS FEEDER CO.,

1, CHARTERHOUSE STREET, LONDON, E.C.1.

Telegrams : Natiglaso, London. *Telephone Nos. :* Holborn, 140 and 141.

If, now, a piece of strained glass is placed in the beam of light between the polarizing plate and the nicol, parts of the glass will apparently be coloured differently than the original field. If well-annealed glass is examined, practically no change in colour will be seen and if a highly strained piece of glass is used, the colours will be vivid. If the tint plate is removed and the same pieces of glass are examined, the first (moderate strain) will appear bright in certain areas, the second (no strain) will produce no change, and the third (high strain) will be very bright or even coloured in some places.

Irregular Shapes.

Some ware, on account of its irregular shape, can not be examined satisfactorily without putting it in a "tank." An immersion tank with two plate glass windows* (which should be free from strain) is satisfactory for this purpose and for best results it should contain a liquid whose index of refraction is as near as possible to that of the glass being tested†. Water or solutions of salts in water are better than nothing, but some organic liquids are much superior. Monochlorbenzene is very satisfactory for most soda-lime glasses; its odour is not disagreeable, but it is somewhat flammable and should not be used in too close proximity to fires. Carbon tetrachloride, although it does not have quite the right index of refraction, is much better than water, and the fire risk is almost negligible.

Temperature Changes.

Glass being tested should be absolutely uniform in temperature. Ware taken from a room warmer or colder than the room in which the testing is done will show different amounts of strain than if allowed to come to thermal equilibrium. Even the effect of the heat from an inspector's hand will be pronounced, especially if the ware is thick. Ware directly from the lehr may look very bad or very good, but after becoming cool it may look quite different.

Position of the Ware.

The exact position in which a piece of ware should be placed in the field of the polariscope is difficult to define, because it depends on the shape of the ware. However, this can be determined by examining the piece while gradually changing its position, the one desired being that in which the greatest change in intensity or colouration is observed.

General Considerations.

The question, "How well should glass be annealed," is frequently asked. There is no definite reply to this except to say that it should be sufficiently free from strain to serve the purpose for which it is intended. This can only be determined by experience, but with similar shapes in different sizes, the larger pieces should be more carefully annealed than the smaller ones.

The majority of ware should probably be very well annealed because practically all of it is subjected at times to sudden temperature changes. This is especially true of hollow ware, which is repeatedly washed with hot water or steam and then cooled rapidly. Plate and window glass might be stronger if it were not completely free from permanent strain because it would then be better able to withstand pressure such as that produced by wind.

Standards.

The use of standard samples for controlling the effectiveness of the annealing operation is probably the most satisfactory method. Comparison of the daily work with such standards gives a definite idea of what is going on in the lehr, and frequent comparison with properly selected standards will unquestionably assist glass manufacturers in determining and maintaining the conditions necessary to anneal their glass properly and consistently.

Owing to the greatly increased cost of imported coal—in some instances three times the cost of that used before the strike—some glass manufacturers have decided to increase their prices. Usually the increase has been about 10 per cent.

◆ ◆ ◆

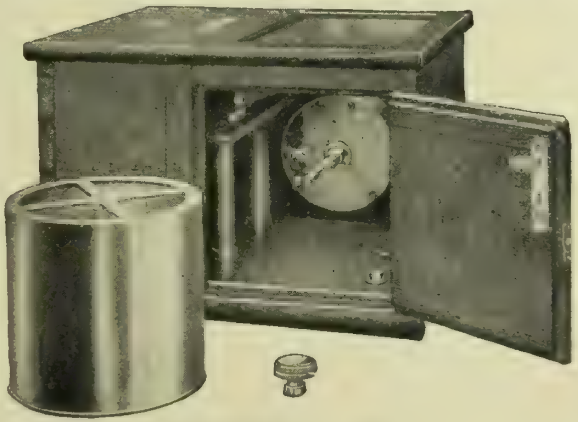
It is claimed that an American factory is carrying out tests in which metallic alloys are used instead of the ordinary refractories and that the results have proved very encouraging.

---

* Glass can be cemented to metal with a mixture of glue and plaster of Paris if the tank is to contain non-aqueous liquids, or with shellac and powdered flint if aqueous liquids are to be used.

† When the immersion liquid matches the glass, the immersed sample becomes practically invisible.

SIEMENS
TEMPERATURE RECORDER



Drum Recorder, Type M.V.R.G.

This Recorder gives a permanent record of temperature variations on a clockwork-driven drum, which rotates once in 24 hours. No batteries are required.

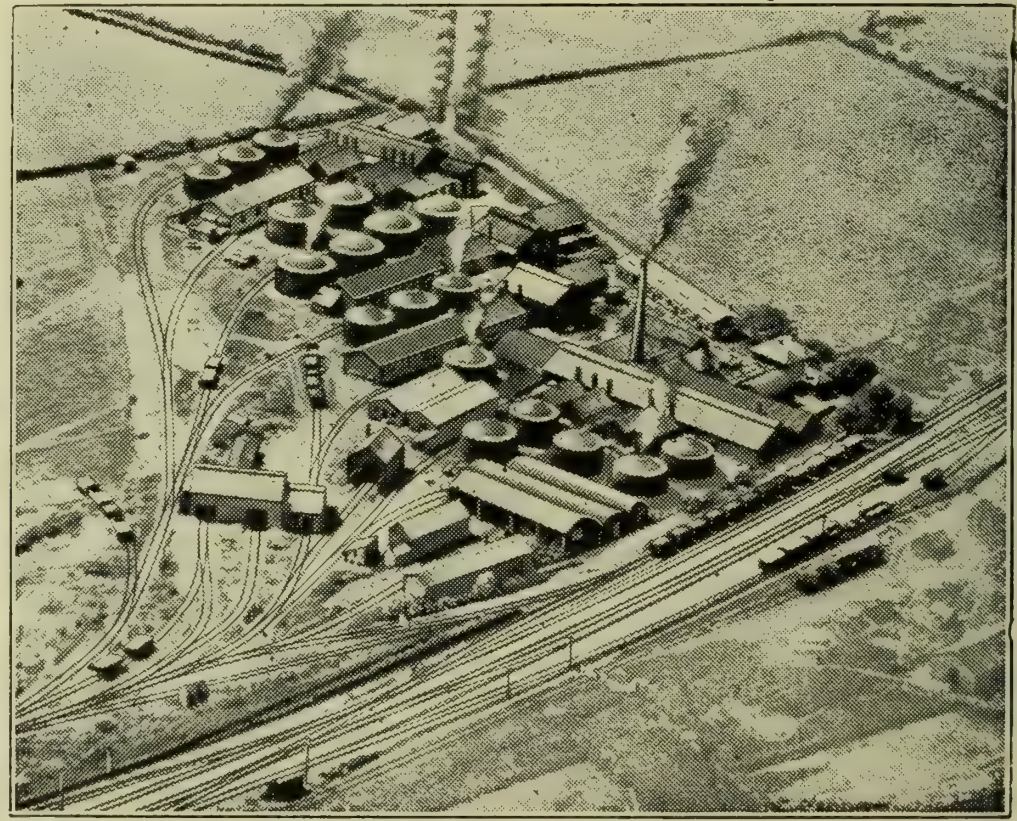
Further particulars and pamphlets on application.

SIEMENS BROTHERS & CO., LTD.,
WOOLWICH, S.E.18.
ESTABLISHED 1858.

THE MOST DURABLE **BRICK**
MADE FOR **GLASS FURNACES.**

STEPHENS SILICA "C"

EXTREMELY REFRACTORY, TOUGH AND DURABLE.



VIEW TAKEN FROM AN AEROPLANE.

Kiln Capacity 1½ Million Bricks. Works Cover over 9 Acres.

SUPER SILICA CEMENT for setting SILICA BRICK.

Used by most of the principal GLASS WORKS.

STEPHENS & CO., KIDWELLY.

The Use of Compressed Air—*Continued.*

By ROBERT WILSON.

Power Required to Drive Air Compressors.

It is very convenient to value the horse power required to drive an air compressor, under normal working conditions, on the basis of 100 cubic feet of free air compressed and delivered per minute. This basis can be worked out from Table III—given in the preceding article.*

Example (1).—What brake horse power is required at the wheel of an air compressor having a capacity of 100 cubic feet of free air per min. when compressing the air from atmospheric pressure at sea level to a pressure of 40 lbs. per sq. in. gauge?

From Table III (Col. 5) the actual i.h.p. in the compressor cylinder, per cubic foot of free air compressed and delivered at 40 lb. pressure per sq. in., is .111.

Therefore, for 100 cubic feet the i.h.p. would be .111 × 100 = 11.1.

From Col. (6) the mechanical efficiency is .850 or 85 per cent. Therefore, the brake horse power at the compressor wheel is equal to

$$\frac{11.1}{.850} = 13.1 \text{ b.h.p.}$$

Example (2).—If in example (1) the pressure required was 20 lb. instead of 40 lb. per sq. in. gauge, what b.h.p. would then be required at the compressor wheel?

Again from Table III the actual i.h.p. per cubic foot compressed and delivered at a pressure of 20 lb. per sq. in. is .074 and per 100 c. ft. equals

$$.074 \times 100 = 7.4$$

Mechanical efficiency is .800 or 80 per cent. so that the b.h.p. at the compressor wheel $= \frac{7.4}{{\cdot}800} = 9.25.$

volumetric efficiency will be taken. In this latter assumption assistance may be derived from the references made in earlier articles to the clearance ratio in the average compressor. This was shown usually to exceed 3 per cent., and may be taken as nearer to 5 per cent. for most modern high speed compressors in which the stroke is comparatively short.

The use of the diagram in Fig. 8 for the purpose of calculating the approximate b.h.p. required to drive an air compressor is best shown by a numerical example.

Example (3).—A compressor has a double acting cylinder 12″ dia. × 8″ stroke. What power is necessary to drive it at a speed of 250 r.p.m. when compressing to 40 lb. pressure per sq. in. gauge? Assume the clearance ratio to be 5 per cent.

Area of cylinder = 113.1 sq. in.
Piston speed = 333.3 ft. per min.
Then Piston Displacement $= \frac{113.1}{144} \times 333.3 =$ (say) 262 c. ft.

Volumetric efficiency at 40 lb. press. from Fig. 8 = 85 per cent.

I.H.P. per cubic foot of free air compressed and delivered at 40 lb. press. per sq. in. (from Table III) = .111.

Mechanical efficiency (from Table III) = .850.

Therefore, b.h.p. at compressor wheel equals

$$\frac{262 \times .85 \times .111}{.850} = 29.$$

This result can be checked with the result obtained in example (1) as follows:

B.H.P. required per 100 c. ft. of free air delivered per min. compressed to 40 lb. pressure per sq. in. as per example (1), 13.1.

Table IV.

B.H.P. required at Compressor Wheel per 100 cubic feet of free air compressed and delivered per min.

Gauge Pressure lb. ..	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
B.H.P. at Compressor Wheel	7.2	8.2	9.3	10.2	11.5	12.5	13.1	13.7	14.6	15.5	16	16.8	17.2	18	18.5

Horse Power Based on Piston Displacement.

In a similar way the values for a capacity of 100 cubic ft. of free air per minute for other pressures can be ascertained and tabulated, but it is to be noted particularly that the figures obtained by the methods exemplified are based on the actual capacity and not on the piston displacement. If the capacity is uncertain and the cylinder diameter, stroke and revs. per minute are known, the b.h.p. required for a given pressure can be calculated approximately by assuming a value for the volumetric efficiency. This value may be obtained from the diagram shown in Fig. 8, page 199, April issue, but a further assumption as to the ratio of the clearance volume to the piston displacement volume is required in order to decide from which curve the value for

Therefore b.h.p. required for a machine having a piston displacement of 262 cubic ft. per min. and a volumetric efficiency of 85 per cent., when compressing to 40 lb. per sq. in. gauge, would be

$$\frac{262 \times .85}{100} \times 13.1 = 29$$

which figure agrees with that obtained in example (3).

In Table IV are given the values of the b.h.p. required at compressor wheel per 100 cubic feet of free air delivered per min. when compressed to various gauge pressures. These figures can be regarded practically as constants and used to ascertain the power required for larger or lesser capacities.

The power required for capacities greater than 100 cubic ft. would be in proportion to above values, that is,

---

* Aug., pp. 373.

PARKINSON & SPENCER, Ltd.

Ambler Thorn Fireclay Works,
HALIFAX, YORKSHIRE.

ESTABLISHED
1800.

Telephone : No. 1207.
Telegrams : Parkinson & Spencer, 1207 Halifax

Manufacturers of Refractory Goods of every description for the Glass industry, viz:

GLASS-HOUSE POT CLAY, FIRE CLAY, FIREBRICKS, TANK BLOCKS, BINDERS, etc.

Our Tank Blocks are unsurpassed for quality and durability.

WE SPECIALIZE IN BEST POT CLAY MATERIAL.

New Plant recently erected for the cutting and dressing of Tank Blocks to any dimensions.

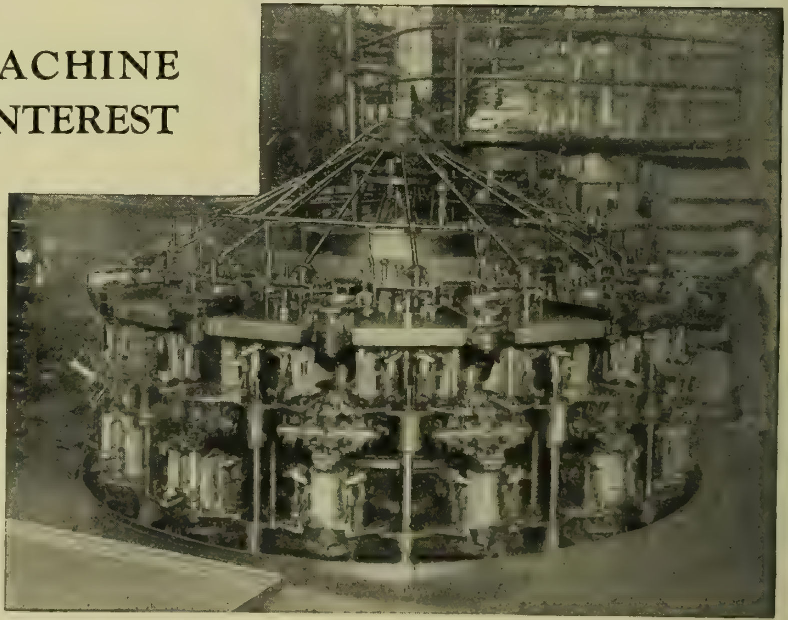
FAVOUR US WITH YOUR ORDERS AND YOU WILL BE SATISFIED WITH RESULTS.

NEW GRAHAM MACHINE CREATING GREAT INTEREST

Offers unusual advantages because of improved construction. Eliminates intermittent rotation which causes wear and tear through jerking. Continuous rotation permits larger production and lower operating costs.

Flexibility of operation appreciated. Produces both narrow and wide mouth bottles in wide range of sizes. Makes push-up bottoms without separate operation.

Three sizes of same construction.
AZ Machine, 15 blank and 15 blow molds
AY Machine, 10 blank and 10 blow molds
AY6 Machine, 6 blank and 6 blow molds
Molds and mold operating parts are interchangeable.



AZ Flow Type—Maximum Speed 72 Bottles per Minute

THE OWENS BOTTLE COMPANY—TOLEDO, OHIO, U. S. A.

Ask us for illustrated catalog, giving complete information.

for a capacity of 600 cubic ft. to 40 lb. pressure per sq. in. the b.h.p. required at compressor wheel would be as follows :—

B.H.P. per 100 cubic feet capacity to 40 lbs. pressure per square inch 13.1

B.H.P. for 600 cubic ft. capacity $= \frac{600}{100} \times 13.1$

$= 78.5$ (say) 80.

For capacities less than 100 cubic feet of free air per minute the proportion might not be exactly in accordance with the figures tabulated above, depending upon the value of the mechanical efficiency, which for machines of small capacity is usually lower than the average values given in Table III. It is advisable, therefore, to allow a small margin, say 5 per cent., on the proportionate figure as found from Table IV for capacities less than 100 cubic feet.

Example (4).—What b.h.p. is required at the flywheel of an air compressor having ONE single-acting cylinder 8 in. diameter by 6 in. stroke and making 400 revs. per min., when compressing to 35 lb. pressure per sq. in., the clearance ratio being assumed to be 5 per cent ?

The Piston Displacement $= \frac{50.26}{144} \times \frac{2 \times 6}{12} \times \frac{400}{2}$

= (say) 70 cubic feet.

Volumetric Efficiency for 5 per cent. clearance (from Fig. 8—page 199) 87 per cent.

Therefore capacity $= 70 \times .87$

= (say) 61 cubic feet

and (from Table IV) b.h.p. $= \left\{\frac{61}{100} \times 12.5\right\} + 5\%$

= (say) $8\frac{1}{4}$.

Horse Power Required for Steam Driven Compressors.

In a steam-driven compressor the power developed in the steam cylinder would practically be equivalent to the b.h.p. required at the compressor wheel, the difference between the i.h.p. in the steam cylinder and the i.h.p. in the air cylinder representing the mechanical losses, and the ratio between these two powers representing the mechanical efficiency of the machine. As a general rule, however, the steam cylinders of an air compressor are designed to develop about 10 per cent. more power, under normal working conditions, than is actually required for the duty specified, this provision being equivalent to giving the machine the capacity for overload. With an electric drive it is always possible for the motor to take an overload should this be required, but the only way in which the same provision can be made in a steam driven machine is either to increase (temporarily) the steam pressure or to make the cubic capacity for live steam amply big. The steam pressure cannot be increased conveniently at a moment's notice, especially while the machine is running, but ample capacity for live steam not only guards against overload due to higher air pressure but also ensures that the speed of the machine will not be seriously affected by a drop in the steam pressure.

Allowance for Friction Drives.

Where the compressor is driven by means of a friction drive such as belt, ropes or gearing, allowance must be made for the friction in the drive. The allowance necessary varies with the type of the drive and the arrangement of the drive. For low pressure machines 10 per cent. is an average allowance for a belt drive, where the ratio of the pulleys is not more than 3 to 1 and the centres sufficiently wide apart to give about the maximum belt contact. Where the centres are comparatively close and a jockey pulley has to be employed, the allowance required may be rather more than 10 per cent. The allowance for rope drives is about the same as that for belt drives. The allowance for gearing varies with the type of gearing and may be from 3 per cent. to as high as 8 per cent.

Compression Efficiency.

From Table III it is possible to determine the average efficiency of compression for different air pressures. Column 3 gives the power required if the pressure could be produced by the isothermal process, and the ratio of the isothermal power to the power actually developed in the compressor cylinder—as given in column 5—gives the compression efficiency.

Thus, for a pressure of 40 lb., an average compression efficiency is

$$\frac{.084}{.111} \times 100 = 75.5\%$$

At 20 lb. pressure the compression efficiency would be

$$\frac{.055}{.074} \times 100 = 74.5\%$$

At 60 lb. pressure the compression efficiency would be

$$\frac{.104}{.135} \times 100 = 77\%$$

It will be noted that the compression efficiency improves as the pressure increases, which amplifies the explanations given in preceding articles.

Overall Efficiency.

The overall efficiency is the ratio of the work which would be required if the volume of air delivered could be compressed isothermally, to the actual work done in driving the machine. The latter figure should include all forms of mechanical loss, such as the efficiency of the prime mover and the amount of the friction in the drive, but as these latter are variable, they have to be determined for each particular case. It is possible, however, from Table III to take a figure for the overall efficiency in the compressor itself, that is, the ratio of the b.h.p. at the compressor wheel to the isothermal h.p. in the air delivered from the compressor.

Thus, for 40 lb. pressure the overall efficiency would be

$$\frac{.084}{.131} \times 100 = 64\%$$

At 20 lb. pressure, the overall efficiency would be

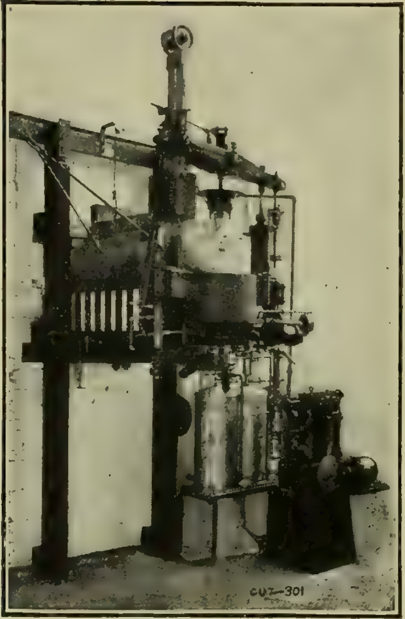
$$\frac{.055}{.092} \times 100 = 60\%$$

At 60 lb. pressure, the overall efficiency would be

$$\frac{.104}{.160} \times 100 = 65\%$$

For belt or rope driven machines the above figures would be multiplied by 0.90 in order to allow for the 10 per cent. loss due to friction and inertia in the drive.

[*Continued on page* 433.



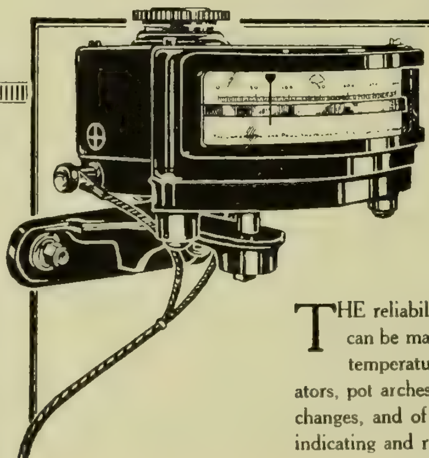
MODEL KFO.

Latest Miller Feeder

PROGRESSIVELY DEVELOPED SINCE 1907.

By arrangement with **The Morgan Crucible Co., Ltd., Battersea,** a stock of all refractory parts for our feeders is now kept in London.

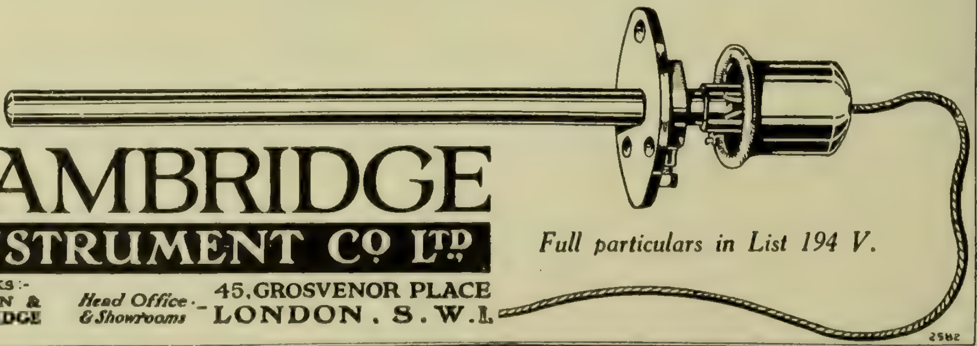
WILLIAM J. MILLER, Inc., SWISSVALE, PA., U.S.A.
London Office : **366, Strand, London, W.C.2.**
Tel. No.: Regent 5647.
Cables : Autoglasma, Rand, London.
Autoglasma, Pittsburg, Pa.



CAMBRIDGE THERMO-ELECTRIC PYROMETERS

Ranges up to 1400° C.

THE reliability of Cambridge Pyrometers, and the ease with which they can be maintained, render them especially suitable for measuring stack temperatures, the temperatures of lehrs, annealing furnaces, recuperators, pot arches, etc. They are accurate, readily responsive to temperature changes, and of robust construction. Indicating, recording, or combined indicating and recording outfits supplied.



CAMBRIDGE
INSTRUMENT Cº LTD
WORKS:-
LONDON & CAMBRIDGE
Head Office & Showrooms - 45, GROSVENOR PLACE LONDON . S.W.1.

Full particulars in List 194 V.

12

2582

THE SELECTION OF ELECTRIC MOTORS.

(*Continued*).

The majority of alternating current (usually written A.C.) motors for industrial purposes may be divided into two main classes, "squirrel-cage" and "slip-ring" machines, each possessing features which make it pre-eminently suitable for certain applications, but it may be stated at the outset that a well designed and constructed "squirrel-cage" motor is probably the most robust, reliable and simple form of electrical machinery.

Owing to the principle upon which this class of motor operates, the rotating part or "rotor" is entirely free from any external electrical connections, consequently the need for rubbing contacts as exemplified by the commutator and brushes of a direct current machine is completely eliminated. This at once reduces the attention required to the mere question of keeping them clean and renewing the oil in the bearings occasionally, so that from the point of view of upkeep and maintenance costs they are unquestionably the cheapest and most reliable form of motive power.

The "no-load" speed of squirrel-cage motors is determined by two factors—the frequency or periodicity of the supply circuit upon what they operate, and the number of poles for which the motor is wound. The actual relationship is given by the formula

$$S = \frac{120 \times F}{P}$$

where S = no load speed in r.p.m.
F = frequency in cycles per second.
P = number of poles.

Thus a 6-pole motor designed for a 50 cycle circuit would have a no-load speed of

$$\frac{120 \times 50}{6} = 1000 \text{ r.p.m.}$$

Standard motors are generally available with 4, 6, 8, 10 or 12 poles, so that it follows that the choice of no-load speeds is restricted to 1,500, 1,000, 750, 600 or 500 r.p.m. for a 50-cycle supply circuit. In the smaller sizes 3,000 r.p.m. can be obtained, whilst the larger machines are also available at 428 r.p.m. and lower if specially required. If for a 60-cycle circuit, the corresponding speeds will be 20 per cent. higher, whilst on a 40-cycle supply they would be 20 per cent. less than the figures just given.

These no-load speeds are usually known as the "synchronous" speeds of the respective machines, and between no-load and full load there is a drop in speed which varies from 2 to 3 per cent. for the larger sizes to 6 or 7 per cent. for the smaller machines. This drop in speed is usually referred to as the "slip."

It will be seen, therefore, that the squirrel-cage motor may be classed as having an almost constant speed over the full range from no-load to full load.

Occasionally it is necessary to have a motor, the synchronous speed of which may be altered, and this feature is obtainable in special machines where, by means of a change-over switch, the arrangement of the windings is altered so as to vary the number of poles. This alteration will change the synchronous speed in accordance with the formula previously given.

Coming now to the question of starting. Squirrel-cage motors are not generally suitable for starting up against heavy load. This is due to the fact that in order to enable them to start under these conditions they take a very heavy starting current, which in turn is liable to disturb the voltage of the supply system. If switched straight on to the supply mains, a motor of this class will exert a starting torque equal to approximately $1\frac{1}{2}$ times full load torque, but the starting current will be from 4 to 6 times full load current. It will therefore be found that the supply authorities generally fix a limit either as to the maximum horse power of a S.C. motor that may be started in this way or as to the maximum starting current that a motor is allowed to take. This is a point that it is essential to watch, as the actual limits vary with different districts. Before installing a motor of this class it is therefore always advisable to find out the regulations existing on this point, as it has a material influence on the type of starting apparatus that is necessary.

If it is found that the regulations will not allow of the motor being started by switching straight on to the supply mains, various types of starters are available for reducing the starting current (these will be dealt with later), all of which, however, are simply means of applying a reduced voltage to the motor terminals for starting purposes. A reduction in voltage, however, means a reduced starting torque, and it is therefore important to see that the load to be started against is less than the starting torque developed by the motor.

Fig. 2 shows the relationships existing between starting current, starting torque and applied voltage for a typical squirrel cage motor.

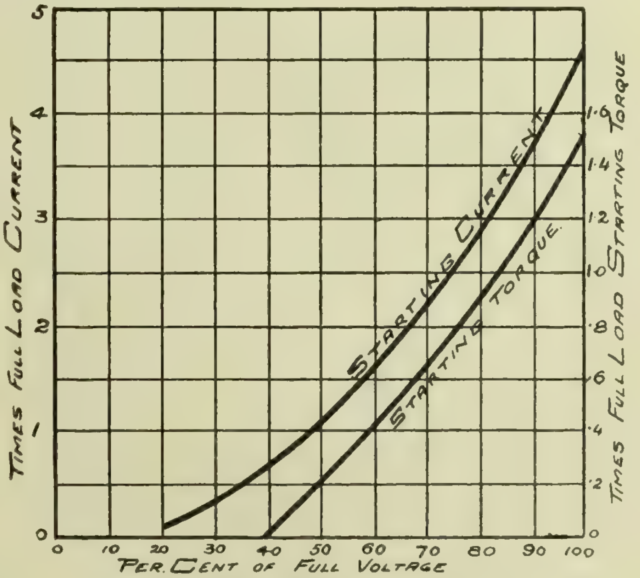


Fig. 2.

Owing to the exceptional simplicity and reliability of these machines it is often advisable and profitable to adopt special means in order that they may be

[*Continued on page* 427.

TELEGRAMS:
"GLASMACHIN, ESTRAND, LONDON.
CABLES:
"GLASMACHIN, LONDON"
CODE:
BENTLEY'S.
TELEPHONE:
CENTRAL 5985.

C. SAXTON, A.M.I.E.E., M. IRON AND STEEL INST., Etc.

CONSULTING ENGINEER

Talbot House,
Arundel Street,
Strand, London, W.C.2.

BOTTLE MOULDS

ORDER YOUR MOULDS FROM

E. LUNN & Co., MOUNT STREET, GLASGOW.

Largest MAKERS of MOULDS in the UNITED KINGDOM

Quick Deliveries and Complete Satisfaction Guaranteed.

MOULDS FOR ALL TYPES OF MACHINES SUPPLIED

ALL MOULDS MADE OF CHILLED CASTINGS ONLY.

Telephone— WESTERN 2792.

Telegrams— GLASMOLD, GLASGOW.

ONE OF OUR RECENT TESTIMONIALS—

"We have one set of Ordinary Round Quart Moulds which you supplied to us which have been working for 2½ years. These are still in perfect condition, showing no cracks or any other flaw in the metal. They have been working almost continuously for the above period, only being off the machines for a week or two at a time. We have also other moulds in Square, Oval and special shapes which have been working quite as long as the Ordinary Round Quarts, although not so continuously, and these also are in perfect condition. We have always found your moulds more satisfactory than any others, and the metal you use is much more durable than any supplied by other firms."

Reference on our Testimonial File : A.B. 91.

Trade "TWENTY MULE TEAM" Mark

Granulated

BORAX

Specially refined for ENAMELLERS AND POTTERS

BRITISH MANUFACTURE.
Guaranteed 99·50% pure.

Entirely free from phosphates.

BORAX CONSOLIDATED LTD,
16, Eastcheap, LONDON, E.C.3.

TRADE NOTES.

The first meeting of the 1926 Winter Session of the Institution of Fuel Economy Engineers will be held on Friday, September 24th, at 6 p.m., in the Lecture Theatre of the Royal Society of Arts, John Street, Adelphi, W.C.2, when Dr. A. E. Dunstan will read a paper on the subject of "Liquid Fuels." Dr. Dunstan is chief chemist to the Anglo-Persian Oil Co., Ltd.

◆ ◆ ◆

Mr. Edward Miller, of the Miller Machine and Mould Works, Columbus, Ohio, is at present visiting England. Whilst over here his headquarters are at the offices of his European Representatives, The British Hartford-Fairmont Syndicate, Ltd., Audrey House, Ely Place, London, E.C.1.

◆ ◆ ◆

According to a statement by Mr. C. W. Brown, President of the Pittsburgh Plate Glass Company, the directors have authorised the initial expenditure of £200,000 for alterations and experiments at the company's Ford City factory. It was here that the original experimental continuous process tank was built and operated.

The results being obtained at the company's big factory at Creighton are satisfactory in many ways, but it is felt that the company have discovered a still better process, and the expenditure just mentioned is to enable the necessary experiments on a commercial scale to be carried out.

◆ ◆ ◆

The British Hartford-Fairmont Syndicate, Ltd., inform us that they have received an order from the Moss Glasvaerk, Moss, Norway, for two British built Hartford single feeders and two British built Hartford lehrs.

◆ ◆ ◆

Messrs. Sowerby's Ellison Glass Works, Ltd., Ellison Glass Works, Gateshead-on-Tyne, advise us that they are giving up possession of their office and show rooms at 19, Basinghall Street, London, E.C. and are moving into new premises, "Gardiner House," 10, 12 and 14, Charterhouse Street, E.C.2.

The exact date of this change will be notified later.

◆ ◆ ◆

According to advice from Czecho-Slovakia, there was a heavy drop in the Czecho-Slovakian exports of white glass to Germany during the first five months of this year as compared with the corresponding period in 1925. The value fell from 31,500,000 crowns (£192,000) to 5,200,000 crowns (£31,700). The same also applies to the exports of polished glass. In this case the value fell from 10,200,000 crowns (£62,200) to 700,000 crowns (£4,270).

◆ ◆ ◆

Fuel economy and technology are continually attracting more attention and co-ordinated effort, and a further development in this direction has now occurred as the subject has been accorded a place in Government activities. The formation of a National Fuel and Power Committee was recommended by the Royal Commission on the Coal Industry, and this has now been appointed, the Chairman being Sir Alfred Mond, M.P.

The function of the Committee is to consider and advise on questions affecting the economic use of fuels and their conversion into various forms of energy, regard being paid to national requirements both in public services and industrial processes.

◆ ◆ ◆

The National Employers' Mutual General Insurance Association, Ltd., has made a thorough analysis of the causes of accidents in workshops and factories, and the results obtained prove conclusively that (a) over 80 per cent. of all industrial casualties can be traced to the human factor; (b) less than 30 per cent. involved machinery to any degree; (c) a reduction of only 10 per cent. can be anticipated from the fullest provision of known machine safe-guarding; (d) in many works in the country it has been possible to reduce accidents by 87.5 per cent. This last result has been obtained by eliminating the root cause of all accidents, carelessness.

◆ ◆ ◆

The Ceramic Society: Refractory Materials Section.—Autumn Meeting, Thursday, September 9, and Friday, September 10, at the Queen's Hotel, Leeds. Thursday, September 9th, at 10 a.m. General Meeting. "A Further Note on the Influence of Iron Oxide in Promoting the Inversion of Silica," by Mr. W. J. Rees. "Practical Results and Experience in the Drying and Burning of Refractory Materials," by Messrs. F. West and J. W. Fagan. "Refractory Linings for Cement Kilns," by Dr. G. Martin. At 2.15 p.m., Visit to the Burmantofts Works of the Leeds Fireclay Company, Limited. At 7.30 p.m., Dinner at the Queen's Hotel, Leeds. Friday, September 10th, at 10 a.m., "The Influence of Foreign Matter on the Thermal Expansion and Transformation of Silica," by Professor J. W. Cobb, Dr. H. S. Houldsworth and Mr. J. F. L. Wood. "Refractories in the Gas Industry," by Dr. W. T. Gardener. "Note on Modern Clay-Working Machinery as used on the Continent," by Mr. H. M. Ridge. "Note on the Products Obtained by Heating Stourbridge Fireclay with Potassium Chloride," by Mr. C. E. Moore.

◆ ◆ ◆

Deposits of the most refractory fire clay yet found in Canada have been located in Northern Ontario, 55 miles north of Kapuskasing.

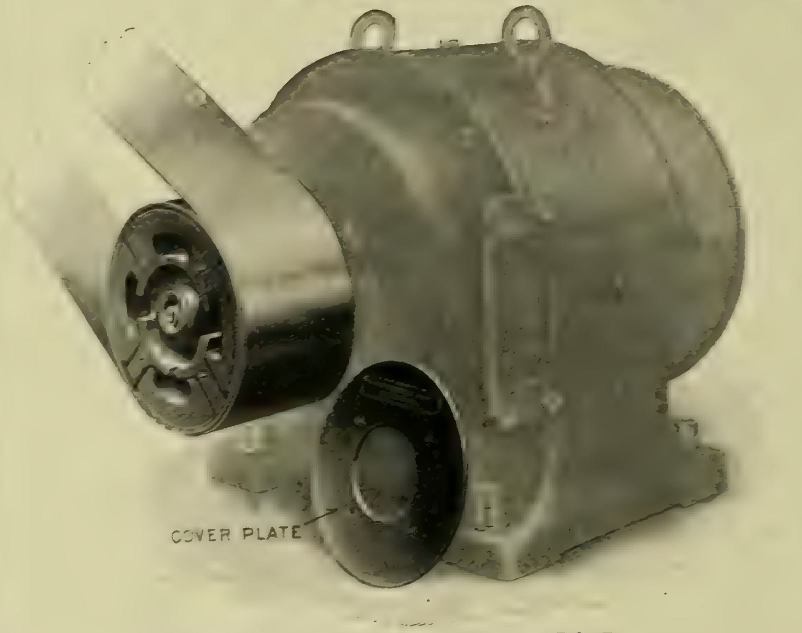
◆ ◆ ◆

According to a London daily paper, a private firm is negotiating with the Admiralty for the purchase of a site near Rosyth dockyard on which to erect a glass works which would give employment to 1,000 men.

◆ ◆ ◆

The following figures are interesting. In 1923 (the last published figures) the income from members of the Registered Trade Unions of Great Britain was £7,980,000. The expenditure in management alone (exclusive of any benefits) was £3,220,000 or over 40 per cent. of the contributions.

"BROADBENT"
PATENT AUTOMATIC CENTRIFUGAL
CLUTCHES.



A "Broadbent" Automatic Clutch Pulley for Belt Drive.

Should always be fitted to Electric Motors.

ADVANTAGES:

Enables Motor to Start up easily against Full Load.

Entirely Dispense with Fast and Loose Pulleys.

Safe Protection for Motor against Overload.

Cheap Motors and Star-delta Starters can be used.

Considerably Reduce Starting Current Consumption.

Entirely Automatic.

Used by most of the Leading Firms throughout the country.

New Catalogues post free.

Thomas Broadbent & Sons, Ltd.
ENGINEERS,
HUDDERSFIELD.
The Largest Makers in the World.

TORPEDO *and* WASP-SHAPE TANK FURNACES

(Designed under Moorshead's Patent No. 227,939)

Constitute the LATEST **PROGRESS** in Tanks.

INCREASE LIFE OF BLOCKS
Avoid stagnant metal.
Save fuel as the corners do no melting.
Ensure smooth running.

By arrangement with Messrs. **U.G.B.,** I can now supply customers in Great Britain and Ireland with these modern types, WHICH ARE SUPERSEDING THE OLD SQUARE TANKS AT MESSRS. **U. G. B. Co.'s** UP-TO-DATE WORKS AT CHARLTON & ST. HELENS, etc.

Send for full particulars and let me quote for altering your old tanks.

TH. TEISEN, C.E.,
FURNACE ENGINEER,
20a, TEMPLE STREET, BIRMINGHAM.
Telephone : Central 1806. *Telegrams : "Tete, Birmingham."*

THE SELECTION OF ELECTRIC MOTORS.

Continued from page 423.

employed in circumstances where at first consideration they would be considered unsuitable owing to this question of high starting current if a decent torque is required. Any way by which the load can be thrown off the motor during the starting period will generally be satisfactory.

For belt drives, fast and loose pulleys immediately suggest themselves, but they are not always convenient to install, and in turn introduce other complications. Lately they have been superseded by some form of clutch, generally of the automatic centrifugal type, which are entirely self contained, necessitate no millwrights' work, or extension of the motor shaft. For rope and belt drives they are available in the form of pulleys and in the case of the motor being a direct drive on to the driven machine, can be obtained in the form of couplings. By their use the motor is enabled to start up under complete no-load conditions and when it has attained say 75 to 80 per cent. of full load speed the load is automatically and gradually applied. (The speed at which they commence to pick up the load can be readily adjusted to suit any special circumstances.) This at once obviates the use of complicated and expensive starting devices to reduce starting current, and at the same time enables the many advantages, including reduced first cost, of the squirrel-cage motor to be retained.

(*To be continued.*)

A NEW METHOD OF MARKING GLASS.

Many manufacturers have long been desirous of marking their products with a trade mark or other sign in order to enable customers and others to identify them, but have refrained from doing so owing to the fact that such marks would detract from the appearance of the article. A patent has recently been granted to an American inventor for a process which, it is claimed, overcomes this inconvenience, as under normal conditions the marks are not visible, but they can easily be made visible by breathing upon the part marked.

Furthermore, the process does not affect the optical properties of the glass, and can be used in connection with lenses, mirrors, etc.

Essentially, the method consists, in the case of a soda-lime glass, of replacing the sodium ions on the surface of the glass by silver ions. This is done by the application of silver nitrate to the portion to be marked, and allowing the interchange to proceed to a very slight degree. If the silver nitrate is applied in the form of a design, such design will be found to be easily though temporarily made visible by the condensation of moisture, if the article is breathed upon, and will remain in view as long as the moisture remains condensed.

BELGIAN GLASS TRADE.

According to commercial reports from Brussels at the beginning of September the condition of the plate glass business is still good in Belgium, and prices, which are fixed on a sterling or dollar basis, are firm and unchanged. The authorised production for the third quarter is 87.5 per cent. of the maximum capacity of polished plate.

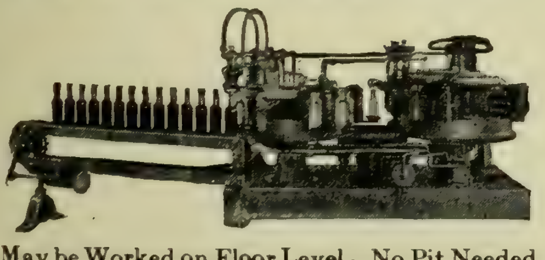
During this month it is expected that the American owned sheet glass factory near Courcelles will commence the production of "drawn plate" as distinct from that made by the "casting" method. The new plant will, it is reported, produce plates with a maximum width of 8 feet at present and the glass will be used for wind screens, etc.

The same process is in use in America, and a somewhat similar principle is employed by the Ford Motor Company, who developed it in conjunction with Pilkington Brothers, but it will be the first to go into operation in Belgium.

This "drawn plate" is also made by the Fourcault process, with extremely satisfactory results, both in France and Czecho-Slovakia, and has already cut into the market for small size plate glass. This in spite of the fact that the Fourcault thick drawn glass is as it leaves the machine and is not polished mechanically.

The demand for Belgian window glass continues sufficient to absorb production at the present rate of working. Machine drawn glass is generally sold at the full tariff rate without discount, but hand-made sheet is available at a slight discount. The attempt to put sheet sales on to a sterling or dollar basis during the recent fluctuation in the franc has met with little success.

AUTOMATIC
NARROW NECK AND WIDE MOUTH
BOTTLE BLOWING MACHINE
No Transfer Boy. No Take-Out Boy.
STRICTLY AUTOMATIC
When Operated with Mechanical Feeding Device.
Can be Worked by Hand Gatherers. Speed 10 to
32 Bottles per minute, ranging in size from ¼ oz.
to Gallon
LYNCH GLASS MACHINERY COMPANY,
ANDERSON, INDIANA, U.S.A.
Cable Address—"LYNCHNOBOY" ANDERSON
Codes—A.B.C. 5th EDITION, BENTLEY'S, WESTERN UNION



May be Worked on Floor Level—No Pit Needed

Many Glass Manufacturers
have PROVED the

MANSFIELD

CRUSHERS and
GRANULATORS

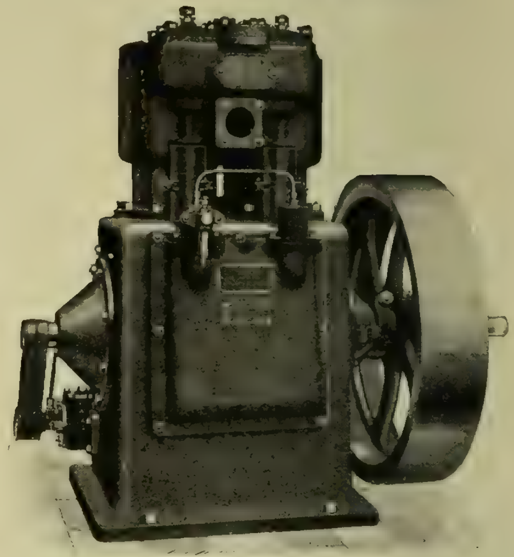
to be the BEST for

dealing with Manganese Ore, Limestone, Saltcake, Cullett, etc., etc.

Materials always remain GRANULAR irrespective of size.

FRANK MANSFIELD & CO.,
9, REDCROSS ST., LIVERPOOL.

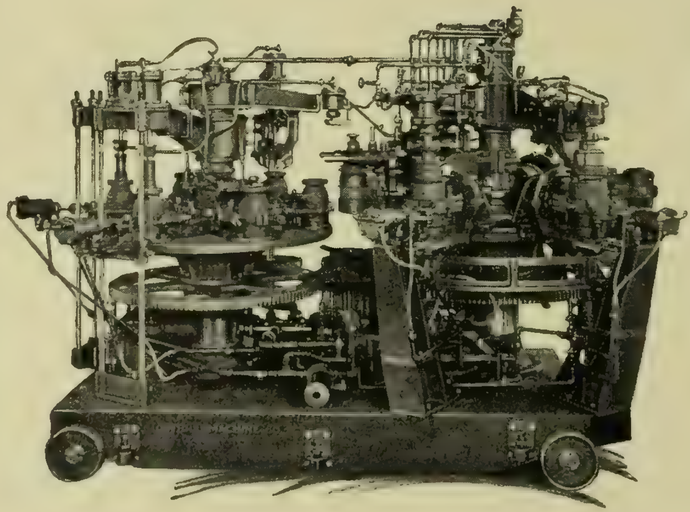
Telegrams : PRECEDENCE, LIVERPOOL.
Telephone : 4925 BANK.



"BROOMWADE"

AIR COMPRESSORS
BRITISH AND BEST
FOR ALL DUTIES.

BROOM & WADE, Ltd., HIGH WYCOMBE



The New O'Neill No. 44 Blowing Machine.

A well-built, high speed blowing machine with a range from 6 oz. to 40 oz. in capacity. Operating speeds up to 23 per minute depending on the class of ware being made. Have our London representative give you the details.

THE O'NEILL MACHINE CO.,
TOLEDO, OHIO, U.S.A.

LONDON OFFICE : 10 SAVOY ST., STRAND, LONDON, W.C.2.

Telephone : Gerrard 7190.
Telegrams and Cables : Oneillany, Rand, London.

The "How and Why" of Pyrometer Resistance.

A clear explanation showing how robust, yet accurate, pyrometers of low resistance, may be applied in many places in glass works.

(*Continued*).

We may now consider the reasons for what may be called the "high resistance obsession" that appears in the advice of many of the experts on the subject. It is clear that, provided one is prepared to accept the delicacy of the high resistance circuit, the indicator of high resistance may be universally applied, being applicable to all cases; it is therefore not difficult to understand the attitude taken by the writer of a book or article on pyrometry in advising the universal use of high resistance instruments. Perhaps the work of explaining the principles, and the conditions under which low resistance might be used, appeared too formidable; may be he doubted the intelligence of the user in following the argument to a correct conclusion, and further, in the majority of cases, he was himself accustomed to handling delicate instruments in the laboratory and ignored or underrated the liability to damage in use in a glass works under practical conditions and in unskilled hands. Probably he failed to differentiate between the skilled technical man who selects the instrument for purchase and superintends its installation and the relatively unskilled furnace man who has afterwards to make hourly use of the pyrometer, month after month, but who need know nothing about its principles of design or whether it was of low or high resistance. In any case such a writer "side-stepped" the issue and "played for safety" by recommending the invariable use of high resistance indicators; if their delicacy resulted in trouble to the user, the blame would fall not on him but on the unfortunate instrument manufacturer. That this attitude did present the manufacturer with a very difficult problem will be evident from study of the figures above and those given later. Great credit is due to the instrument maker in overcoming the difficulties and to the user who took endless trouble in the endeavour to use the delicate instrument and to get the accurate temperature measurements that he knew to be so vital to glass manufacture.

What has been christened the "high resistance obsession" has been reflected in the productions and descriptions issued by manufacturers; they had to meet the demand, and having met it with a fair amount of success, they were naturally enthusiastic about it. This attitude of mind has been, perhaps, most noticeable in America, and in that country a further factor operated to accentuate the tendency. Large scale systematic production is the order of the day in the United States; special study of the individual requirements is not there looked upon with favour, so that the American instrument manufacturer turned almost exclusively to the production of high resistance instruments, and a state of competition was established in which the manufacturer who could produce the instrument of the highest resistance believed, and in some cases got his customers to believe, that he was thereby ahead of his competitors; the fact that his instrument was to that degree more delicate was ignored or glossed over. Another factor that operated in the same direction was that some of the pioneer work on low resistance robust instruments was inaugurated in the United States, but because the art was not sufficiently advanced there at the time and the proper proportioning of the resistances to secure low temperature-error was not followed, the early American instruments of the low resistance type earned a deservedly bad name, and so the pendulum swung very far in the opposite direction. It is, however, interesting to note that some of the American instrument manufacturers hitherto most prominent in the "race for high resistance" are now beginning to "hedge" and are offering a "medium resistance" type for conditions requiring maximum robustness. Probably that title is selected because "low resistance" is still discountenanced there.

In England the national characteristic of avoiding extremes has saved us from over-stressing this point of high resistance so badly, but nevertheless the experience in the United States has been to some extent repeated here, and the advantages following on properly proportioned low resistance instruments are not yet fully realised. Study of the individual cases is not beneath the attention of the English instrument manufacturers, so that the prospective pyrometer user has open to him great advantages in robustness in those cases where low resistance is suitable. To summarise the matter, the low resistance instrument may be used with base-metal thermo-couples where the cable runs are short and of fixed length and with all well designed radiation pyrometers.

In conclusion, a brief note on the very small forces available and their reaction on design and performance will serve to show that the argument is not purely academic, but has a very important influence on the industrial use of pyrometers. Taking the two examples on page 431, the high resistance instrument would have a total deflecting force or torque of not more than 16 dyne-centimetres for the full scale, that is, the torque which would be generated by a pull of 16 milli-grammes upon a thread wound round a pulley of 1 cm. radius, or in English measure a weight of one-fivethousandth of an ounce at a radius of one inch. This is indeed a very small force, yet only a very small fraction of that is available to overcome the pivot friction of the moving coil. Assume the indicator has a scale 0°-1600° C. and that the temperature measured is steady at 800° C., that is, half the scale length, the current through the coil will then generate a torque of $\frac{16}{2} = 8$ dyne-centimetres, but that will be all balanced by the torque of the control springs because the pointer is steady, not moving. Now suppose that the temperature rises to

ONE OF THESE DAYS YOU'LL WISH YOU HAD THAT EXTRA QUALITY.

The colour's "down." What is to blame?
Limestone? Sand?
Manganese? Felspar?

Make your resolution to-day to buy unquestionable raw materials. They come from

C. E. RAMSDEN & Co.,

FOLEY COLOUR AND CHEMICAL WORKS,

FENTON - STOKE-on-TRENT

and cost no more.

Wire: Ramsdens, Stoke-on-Trent. 'Phone: Longton 72.

POTASSIUM NITRATE.
ARSENIC.

POTASSIUM CARBONATE
(HYDRATED & CALCINED)
SELENIUM.

STOCKS HELD AT PRINCIPAL PORTS.

Write to-day for Prices.

THE COOKSON PRODUCE & CHEMICAL CO., LTD.,

3, NEW LONDON ST., LONDON, E.C.3.

'Grams:—COOBUDCOL, FEN, LONDON.
'Phones:—ROYAL 3917, 8, 9, and 4048.

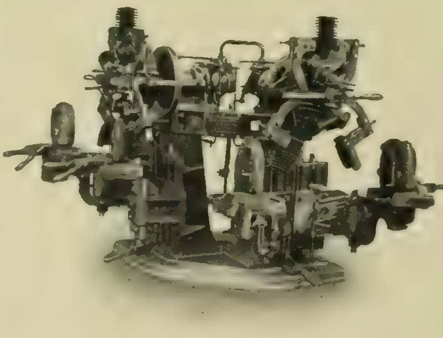
The Cheapest House for Glass Chemicals.

CLEGG'S

Glass Bottle Making Machines.

FOR PLAIN AND SCREW MOUTHS.

Bottle Moulds for Hand-work.



Bottle Moulds for all types of Machines.

Double Head Machine for Screw or Plain Mouths.

A. E. CLEGG, LIMITED,

ENGINEERS,

Balmoral Works, Balmoral Street, HUNSLET, LEEDS.

Telephone: 24634. Telegrams: "Clegg, Engineer, Hunslet, Leeds."

INCREASE THE EFFICIENCY

OF YOUR

FURNACES LEHRS ETC.

BY USING

Highpor Insulating Bricks

AS USED BY THE LEADING GLASS MANUFACTURERS

HIGHEST EFFICIENCY. LOWEST COST.

Send for particulars to DEPT. G.

THE BUILDING & INSULATING MATERIAL COMPANY, LIMITED.

Dene House, Ellison Place,	NEWCASTLE	'Phone: Cent. 1041.
128, Hope Street,	GLASGOW	'Phone: Cent. 1053
198, West Street,	SHEFFIELD	'Phone: Cent. 4038.
9, Albert Square,	MANCHESTER	'Phone: Cent. 5877 & 8.
20a, Temple Street,	BIRMINGHAM	'Phone: Cent. 1806.

and

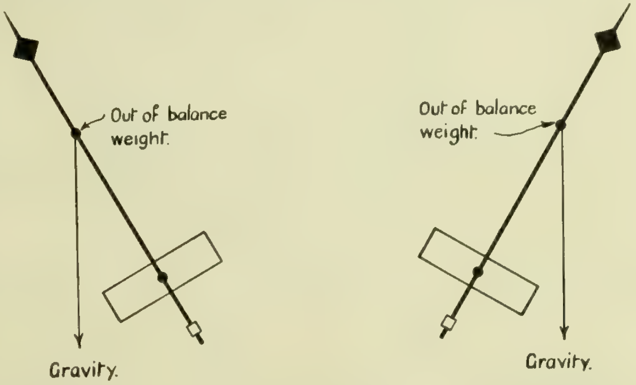
VICTORIA STATION HOUSE, LONDON, S.W.1.

Telephone: FRANKLIN 6107 & 8. Grams.: CHALKINESS, SOWEST.

820° C., there will then be a minute extra torque of one-fifth of a dyne-centimetre $\left(16 \times \frac{20}{1600} = 0.2\right)$ tending to overcome the static friction on the pivot points and to move the pointer up to the new reading. It does not require much imagination to realise that the slightest damage to the pivot point will result in friction too great to be overcome by this very small force; the instrument will not respond to the change of temperature, it will be "sticky." Tapping the instrument lightly will assist the movement by the vibration, but the unskilled user, observing the tapping, often develops the habit of knocking the instrument severely and thus aggravating the damage to the pivots. As already mentioned, the weight of the moving coil and its attached pointer is kept very low in good modern instruments, yet because the pivot point must be very fine, the calculated stresses, in tons per square inch, are such as would horrify an engineer accustomed to larger constructions. It is therefore easy to see that mounting the bearing jewels on a special resilient system, which has been developed in later years, has greatly helped to solve the problem of achieving a fair amount of robustness even with a high resistance indicator.

Considering the low resistance instrument, the full scale torque for the same E.M.F. would be 80 dyne-centimetres $\left(16 \times \frac{0.04}{0.008} = 80\right)$ and the fraction to overcome friction for the assumed rise from 800° to 820° C. would be one dyne-centimetre. This force is sufficient, with good design, to ensure that the coil will respond correctly to small changes in the temperature under measurement, in fact it is so large that other advantages in use are available.

Indicators of high resistance, with their consequent low torque, must always be used with the axis of the moving coil approximately vertical, because in that posture the friction at the pivot points is at a minimum. There is also a further reason for this arrangement. If an instrument is required to read accurately in all positions of the axis it is essential that the coil, with its pointer, shall be accurately balanced, thus ensuring that the only forces acting upon it are the torque due to the current flowing in the coil and the opposing torque of the control springs, because, if it were out of balance, there would be an additional torque due to gravity, and this would vary in direction and amount depending on the particular position of the axis and the particular reading at the moment. Reference to Fig. 4 will show this clearly; it is there assumed that the axis is horizontal and that the moving system is out of balance by the pointer being slightly too heavy. It will be seen that, at or near zero, the out of balance effect would act against the deflecting force, the indicator would read too low, but at a large deflection the reverse effect is evident, it would read too high. With a truly vertical axis there would be no gravity effect due to a slight defect in balance, and if the axis were only slightly out of vertical, due to careless fixing of the indicator, the out of balance effect would be relatively small. This consideration is of great practical importance to the user because, although the instrument maker takes great pains to balance the instrument when it is first made, damage in transit or in use may easily cause a small disturbance of the balance, or if one side of an indicator is hotter than the other the consequent greater expansion of one part of the moving system will cause a small disturbance of the originally perfect balance. Now there are certain small disadvantages in the use of an indicator with a vertical axis. In the case of a portable indicator a flat scale may be employed; the user looking down upon it, if his eye is over the centre of the movement, can read with equal accuracy at all parts of the scale. In the case of an indicator for use fixed on a wall at the level of the eye, the end of the pointer is bent down and hangs in front of a curved vertical scale; this is called an "edgewise" instrument. With such types the user must move round till he is



COMPLETE PYROMETER EQUIPMENT
FOR GLASSWORKS.

The "Resilia" construction, exclusive to FOSTER PYROMETERS, ensures reliable service under the worst conditions. Let us give you full information on this and other special features embodied in our instruments.

FOSTER INSTRUMENT CO.,
LETCHWORTH, HERTS.
"The Pyrometer People."

Telephone: Letchworth 26.
Telegrams: "Resilia, Letchworth."

British Instruments for British Industries.

AIR COMPRESSORS & VACUUM PUMPS

As Illustrated in 5 sizes from 10 to 80 cubic feet per minute

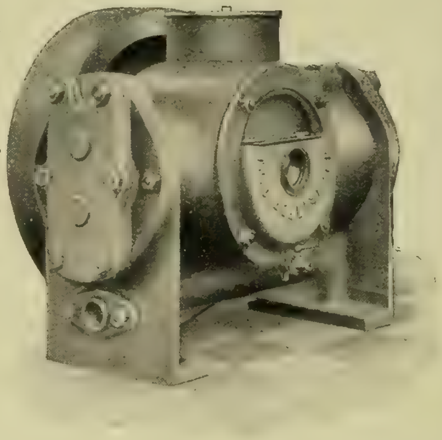
—

Other types Larger sizes

—

Any Pressure or Vacuum

—



LACY-HULBERT & CO., LTD.

BOREAS WORKS, BEDDINGTON
NR. CROYDON, SURREY
Telephone: CROYDON 1698.

Moulds

Machined to specification from finest crucible chilled castings by highly skilled craftsmen; our works equipment ensures accuracy and superiority of finish.

SPECIALITIES—

Mould equipment for **Lynch, Miller, O'Neill** and other Automatic Machines.
Glassworks Patterns, Crucible Iron Castings.

ALL ORDERS EXECUTED PROMPTLY.

Johnson Radley & Sons, Ltd.,
Chesney Works, Hunslet, LEEDS.

Telegrams—MOULDS, LEEDS. Telephone—LEEDS 21354.

TECHNICAL BOOKS.

The following are of special interest :—

A TEXTBOOK OF GLASS TECHNOLOGY.
Hodkin & Cousen. 551 pp. 251 Illustrations.
42/- net.

MODERN GAS PRODUCERS.
N. E. Rambush. 545 pp. 356 Illustrations.
55/- net.

THE FLOW OF GASES IN FURNACES.
Groume-Grjimailo. 397 pp., including Appendix on Furnace Design.
27/6 net.

OIL FUEL.
Its Supply, Composition and Application.
E. Butler. 4th Edition. 310 pp. 158 Illustrations.
12/6 net.

INDUSTRIAL FURNACES.
W. E. Trinks. Vol. 1. 2nd Edition.
22/6 net.
Vol. II. 405 pp. 292 Illustrations.
27/6 net.

THE DECIMAL PLATE AND SHEET GLASS CALCULATOR.
Samuel S. Lindsay,
Comptroller of the Pittsburgh Plate Glass Company.
29/6 net.

One large glass company estimate they are saving £600 a year in one department by the use of this book.

ANY Technical Book can be obtained from—

GLASS PUBLICATIONS, LTD.,
Talbot House Arundel Street,
Strand, LONDON, W.C.2.
Telephone : Central 5985.

opposite the particular part of the scale where the pointer is, or he must rotate the indicator itself; accurate readings are not so quick as with a flat scale, but this disadvantage must be accepted with an instrument of high resistance and low torque.

A further advantage of the low resistance high torque indicator now appears. Because of the much larger forces available (five times as great) the effect of a small change in balance is negligible so that an instrument with a horizontal axis of movement may be used. In an indicator or recorder to be fixed on a wall the scale or chart may be flat. Of course the friction effect on the pivots is also slightly greater than with a vertical axis, but the much larger forces make this also negligible; thus it is seen that the low resistance indicator may have a flat scale just like an ordinary ammeter, with a gain in the speed and ease with which accurate readings may be made.

Still further practical gains may follow from the use of the low resistance indicator when used with base-metal thermo-couples for relatively high temperatures. In the two examples taken above the E.M.F. was assumed at $\frac{20}{1000}$ volt (20 millivolts), which would correspond to a scale of 0°-1600° C. with a rare-metal thermo-couple or a range of 0°-400° C. for one of well chosen base-metals. If we consider a pyrometer for a lehr with a range of 0°-650° C. the base-metal E.M.F. would be about $\frac{35}{1000}$ volt (35 millivolts). According to Ohm's law larger E.M.F. generates larger current so that, for the two examples taken the currents would be nearly doubled $\left(\frac{35}{20} = 1.75\right)$ The corresponding torque for the high resistance instrument would be $16 \times 1.75 = 28$ dyne-centimetres which is an advantage, but leaves the torque still too small to allow anything but a vertical axis of movement. But the low resistance instrument would have a torque of $80 \times 1.75 = 140$ dyne-centimetres, a force so large that some of it may be safely sacrificed to secure greater convenience in use in another direction, namely that of " damping." The meaning of this term is the way in which the swinging of the pointer is "damped" or smoothed out; a well damped instrument is " dead beat," it comes smoothly up to a steady reading without a number of preliminary swings which are annoying and actually waste time where a number of readings have to be taken in succession; further, good damping secures steadiness in reading, even under slight vibration. In the two examples so far considered it has been assumed that the whole allowable weight for the coil has been used for the wire and its insulation. For reasons which would take too much space to elaborate here such a coil does not give the best " damping"; the pointer may swing for some time when connected to the thermo-couple. Although, by good design this swinging may be reduced, some such deficiency in damping must be accepted with low torque high resistance instruments. With the large torque of 140 dyne-centimetres some part of the force may be sacrificed to secure good damping. By taking part of the allowable space and weight with a closed frame or " former" of pure copper, aluminium or silver, electro-magnetic forces are generated by the movement of the pointer opposing and slowing down the swinging (just as currents opposing the rotation are generated in the coils of a dynamo), and thus the instrument is rendered " dead beat." This makes reading quicker and easier and even allows reading a portable indicator held in the hand. By slightly reducing the size of wire in the low resistance coil the resistance of 2 ohms is still retained at a sacrifice of the number of turns, to allow for the " former." In the case taken above the number of turns would be 32. The current would be $\frac{35}{1000} \div 10 = \frac{3.5}{1000}$ ampere, therefore the ampere-turns would be $\frac{3.5}{1000} \times 32 = 0.112$ ampere-turn generating a total torque of $80 \times \frac{0.112}{0.08} = 112$ dyne-centimetres, which is ample to give good robustness with good damping and is actually comparable with the forces in an ordinary ammeter.

To conclude, the advice of one having extensive experience with both types is—study the conditions of installation and then choose the instrument best suited to the particular work in view. There are probably fifty per cent. of the measurements that can be made with low resistance instruments with all their advantages of robustness, simplicity and ease of reading, frequently accompanied by saving in first cost and almost certainly by reduction in maintenance expense.

THE USE OF COMPRESSED AIR.

Continued from page 421.

For a gear-drive the multiplier would be from 0.30 to 0.80, and in order to get the correct overall efficiency the result obtained—after allowing for the loss in the drive—should be multiplied by the figure representing the efficiency of the prime mover. This final figure would give the ratio of the actual power input to the isothermal power in the air delivered from the compressor. As a rule, however, it is considered sufficient to take the overall efficiency in terms of the ratio between b.h.p. at compressor wheel and isothermal i.h.p.

Ratio of Power to Capacity.

The ratio of power to capacity usually is based on the number of cubic feet of free air delivered per minute per b.h.p. required at the compressor wheel. This form of comparison for air compressors is second only to the comparison for reliability and durability, a comparison which can be assisted by a knowledge of the respective weights, designs and construction.

It will be apparent, however, that in order to make a true comparison the capacity of the compressor would require to be measured accurately. The power readings —both i.h.p. and b.h.p.— may readily be obtained by means of indicator diagrams—for indicating air and steam cylinders—or by instruments or apparatus for power-driven compressors, but the methods of measuring capacity are more complicated and vary according to the degree of accuracy aimed at.

THE LONDON LEAD
OXIDE Co., Ltd.

Offices: 107, Bishopsgate, LONDON, E.C.2
Telephone No.: London Wall 4527
Tele. Address: "Londoxid, Ave, London."

Works: Royal Pier Rd., GRAVESEND, Kent.
Telephone No.: Gravesend 112.

MANUFACTURERS OF

GENUINE **ENGLISH** REFINED

GLASSMAKERS'

RED LEAD

Buyers who wish to obtain the very best material at the lowest price should write for samples and particulars.

BRAND
ALOSIL

**SILLIMANITE
BRICKS**

FOR GLASS WORKS

SILICA BRICKS & REFRACTORY GOODS

PICKFORD, HOLLAND & Co. Ld.

SHEFFIELD.

Vitreous Enamel Colours.

Stains for Glass.

Oxides for Colouring Glass Metal.

Selenium Metal.

Selenate and Selenite of Soda.

Ground Bone, Felspar, Flint, Fluorspar, Quartz, Stone, Whiting, Etc.

Carbonate & Sulphate of Barytes

Oxides of Antimony, Arsenic, Chrome, Cobalt, [illegible] Copper, Iron, Manganese, Nickel, Tin, Titanium, Uranium, Zinc, Etc.

TRADE MARK

WENGERS. Ltd.

CERAMIC COLOURS & CHEMICALS

ETRURIA.

STOKE-ON-TRENT

England.

[illegible]

Colours for Potters, Glazed Brick Manufacturers & Glassmakers.

Prepared Enamels for Cast & Sheet Iron, Copper & Jewellery

Limespar.

Phosphate of Lime.

Nitrate of Soda.

Nitrate of Potash.

Opavetro for Opacifying Glass.

Alumina Oxide and Hydrate.

SILLIMANITE

The High Temperature Resisting

Refractory Material.

(*Softening Point above 1800°C.*).

Supplied ground from –10 mesh to –100 mesh. For all bricks, blocks, flue linings, siege coverings, and glasshouse pots and rings.

For the convenience of users who desire to have sillimanite ready prepared with binder, the following mixtures are also supplied dry or ready for use:—

Slip, Pot and Ring Mixtures.
(PROF. W. E. S. TURNER'S Formulæ).

Tank Block, Brick & Pot Mixtures.
(MR. W. J. REES' Formulæ).

Siege Mixture.
(GLASS RESEARCH ASSOCIATION'S Formula).
For lining the floor siege of pot furnaces and general purposes, patching, etc.

The P.B. SILLIMANITE
COMPANY, LIMITED,

Sole Agents: PAWLE AND BRELICK

791, SALISBURY HOUSE,
LONDON WALL, LONDON, E.C.2.

Telephone Number - London Wall 4825.
Telegrams - - PLATOONS, LONDON.

Catalogues.

Pyrometers. Book No. 42 received from the Foster Instrument Company, Letchworth, Herts, contains 50 pages devoted to a description of the thermo-couple (steam) type instruments manufactured by the Company. Details are given of the different types of indicators, recorders, etc., and numerous typical examples are given as a guide to the choice of the correct instruments to suit specific conditions, these being illustrated by means of diagrams. Not the least interesting section is that in which the theoretical side of pyrometers is dealt with.

Pulley Blocks. Book No. 108 from Messrs. Herbert Morris, Ltd., Loughboro' gives full details of the "Morris" worm-gear pulley-blocks. Dimensions, prices, and illustrations of numerous applications are given, together with details of how the blocks may be made additionally useful by employing them in conjunction with trolleys, etc., etc.

Ovil Bruning. The "Rotamisor" liquid fuel burning system is dealt with in a 12-page booklet received from Combustions, Ltd., 31, St. Mary Axe, London, E.C.3. The method of atomising the oil is novel, and requires only a low pressure air supply. The Company claim particular success in applying the system to glass-melting, and have numerous installations in operation on tank furnaces, including one for the melting of pyrex glass.

Sands. From Mr. A. L. Curtis, Westmoor Laboratory, Chatteris, we have received a copy of the second edition of his catalogue of sands, clays, etc., for industrial purposes. The list is illustrated with views of some of the quarries from which the sands are obtained, and gives concise information as to the essential qualities of sands for very many purposes, including glass manufacture.

Mechanical Handling Plant. A 12-page booklet from W. Dederick, Ltd., Stanley House, Dean Stanley Street, Westminster, S.W.1, is devoted to illustrations of a few of the many types of handling equipment designed by Bleichert & Company, of Leipzig, which includes ropeways, cranes, conveyors, electric trucks, etc. British built plant is supplied when required.

Chains. From Hans Renold, Ltd., Burnage Works, Didsbury, Manchester, we have received a copy of their new price list, which came into operation on August 1st, and it is interesting to note that there have been substantial revisions in this respect. A new series of Duplex chains has been introduced to meet the demand of space limitations and compactness of drive.

Totally Enclosed Type Electric Motors. Specification Sheet No. 9 and Dimension Sheet L.7 have been received from Messrs. F. & A. Parkinson, Ltd., Guiseley, Leeds, and are devoted to their new "Klosd" motors. These are totally enclosed type A.C. machines, which, however, due to their patented construction, are only slightly larger than ordinary protected type machines of the same rated capacity.

Optical and General Scientific Instruments. The collection of instruments exhibited at the recent Optical Convention was a remarkable testimony to the ability of British instrument manufacturers. For those who were unable to see them personally during the Convention we might say that they can still obtain copies of the catalogue. This is a book of some 320 pages, and due to the explanatory text and illustrations, really serves as a guide to the latest achievements in the instrument makers' art. Copies may be obtained from the offices of the Optical Convention, 1, Lowther Gardens, Exhibition Road, S.W.7. Price 6/9 post free.

Colours and Chemicals.

Number 45 (July-August) of *Ramsden's Monthly Bulletin for the Glass Industry*, has been received from Messrs. C. E. Ramsden & Co., Fenton, Stoke-on-Trent. It contains the customary short technical article, in the present instance on "Viscosity and the rate of setting," together with a report as to the trend of the market for glassmakers' chemicals.

Small Power Motor Control Gear.

A leaflet from Messrs. Brookhirst Switchgear Ltd., Chester, announces the publication of a new catalogue (No. 10) dealing with an important development in their manufacturing policy, whereby the "Brookhirst" range of electric motor control gear will include a line of "Small Power" apparatus at reasonable and competitive prices.

Colours, Glazes, Chemicals and Sundries.

Messrs. Wengers, Ltd., Etruria, Stoke-on-Trent, have just issued their new Price List, No. 58. This is a volume of some 130 pages and gives prices and particulars of an extremely wide range of the almost innumerable chemicals, raw materials, colours, glazes, accessories, etc., etc. required in modern glass works and the pottery and enamelling industries. Numerous special machines and appliances are also listed, including muffle furnaces, colour sprays, etc. etc. The list is well classified and provided with an adequate index, which adds materially to its usefulness, whilst concise notes are given as to the use of many of the materials. The fact that the Company is able to correspond in at least six of the chief European languages, and also employ metric weights and measures, should be of great assistance to foreign customers.

BOOKS RECEIVED.

The Law Relating to Injuries to Workmen. 3rd Edition (Revised). By Frederick George Neave, LL.D., Effingham Wilson, London. 2s. net.

This book of 160 pages forms one of the series of legal handy books published by Mr. Wilson, and states in non-technical language, the rights of injured workmen at Common Law, as well as under the various acts which have been passed for their protection.

In this 3rd edition the provisions of the recent Acts have been incorporated and all the more important recent cases have been dealt with.

The book contains a vast amount of sound information upon legal points which are generally so vaguely understood.

MECHANICAL GAS PRODUCERS.

In a paper recently presented to the American Society of Mechanical Engineers, J. F. Rogers and V. Windett dealt with the problems arising from the substitution of completely mechanical gas producers for the hand-operated type. These were stated to be as follows :—

1. To gasify a wide range of coals including those less desirable from chemical and physical standpoints. These include coals of high ash content and of low fusibility, and also coals containing a large proportion of " fines."
2. To make a good gas without deterioration in quality or quantity incidental to the cleaning of the fire of the producer.
3. To reduce the hard, exhaustive work of the gas maker, and also the amount of labour per unit weight of coal gasified.
4. To increase the gasification rate per unit of cross-sectional area of the gasification zone without appreciable sacrifice in the quality of the gas. This increase should be such that the investment charge for the completely mechanical producer will be more than offset by its greater earning capacity. The increase in capacity should also effect an economy in the ground space occupied.
5. To secure these results in a producer which, whilst mechanically driven, is simple, durable and accessible in all its operating parts. The producer should also be designed so that improvements as fast as they are developed can be applied without serious alteration.

After dealing with the earlier developments, the authors gave a description of the latest L type machine of the Wellman Seaver Morgan Company, afterwards proceeding to discuss gasification results. Incidentally, it was stated that a gasification rate of 84 lbs. coal per sq. ft. of cross-sectional area per hour had been obtained with several American " run-of-the-mine " bituminous coals.

The question of gasification rates raises that of the calorific value of the gas obtained, and its desirability in the furnaces where it is to be consumed. The calorific value of the gas is generally taken as the net B.Th.U. at 62° F. contained in one cubic foot of the gas as sampled at the gas outlet of the producer, or as near to as is convenient. The usual and most approved method of taking samples is that known as the " continuous method." In this a small stream of gas is taken continuously from a sampling tube in the gas main near the producer. The time of collecting each sample should cover a period of from 10 to 12 hours. The 12-hour period is preferable in that in practically all producers, (every hand and many mechanical) the fires are " broken down," clinkers barred off the walls and the ashes that have accumulated since the last cleaning are removed, these various operations taking place at least once in 12 hours. This causes a fall of the fire through a height equal to that of the ash removed, with a loss of considerable coke from the incandescent zone into the underlying ashes. Such a disturbance causes a serious lowering of the calorific value of the gas, lasting sometimes upwards of an hour before a full recovery is obtained.

" Snap " samples taken over 5 to 15 minutes are only indicative of the producer conditions at the time taken, and by some are considered useful for this purpose.

A gas analysis and the calorific value calculated from it are about the best technical indications of gas producer performance when taken in conjunction with the gas temperature and the ash analysis. As commonly made, a gas analysis does not tell the whole story. The gas is collected in a container full of water at the start and is analysed in aqueous solutions of the reagents, after being passed through loose filtering cotton. The consequence is that the numerical results of the analysis take no account of the high calorific tar vapours, which as a golden yellow fog characterise gas made under the best conditions.

Another inaccuracy is the reporting of the hydrocarbon gases as CH_4 and illuminants. The net calorific values of one-tenth of one per cent. in volume of CH_4, C_2H_4, C_2H_6 and C_6H_6 are respectively 0.9, 1.5, 1.6 and 3.75 B.Th.Us. The usual way of calculating the illuminants is to consider them all as $CH_4 = 0.9$ B.Th.U; the resulting calorific value of the gas of say 0.6 per cent. may thus vary from 5.4 up to 22.5 B.Th.Us.

In general producers should be worked at a low temperature rather than a hot one. These terms being relative it may be considered that in a factory using hot raw gas a coal gas is one between 1000° F. and 1300° F. Where the gas is washed and cleaned and the producers run at a lower gasification rate, the customary gas temperatures are from 950° to 1050° F.

If the final temperature at the top of the fuel bed is higher than necessary there is a danger of breaking up the less stable hydrocarbons, the hydrogen appearing in the gas, the carbon being lost, as it is deposited in the flue as soot.

If, therefore, there is much hydrogen in the gas, it generally shows that the producer has been operating too hot. The other source of hydrogen is the steam of the blast, and if the excess hydrogen is from this source it means too much steam and will be indicated by a higher CO_2 content.

The following shows the improvement in gas producer practice by the introduction of the completely mechanical gas machine.

	Hand-operated.	Mechanically operated.
Rate of gasification per sq. ft. producer cross-section per hour	7.5-10.0 lbs.	50 lbs.
Quality of gas throughout the 24 hours of a day	Variable, from 140 net B.Th.Us down to 80 B.Th.Us during cleaning periods	Constant, averaging 150-170 net B.Th.Us.
Coal gasified per man per day (all labour in producer plant)	3.25 tons	14-20 tons

July Trade Returns.

IMPORTS OF GLASS AND GLASSWARE.

		QUANTITIES.				VALUE.			
		Month ended 31st July.		Seven months ended 31st July.		Month ended 31st July.		Seven months ended 31st July.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)...	value	—	—	—	—	4,729	5,234	35,046	38,160
Glass Tubing and Rod for all purposes... ...	cwts.	333	674	3,520	3,663	1.524	2,625	12,700	12.318
Illuminating Glassware	,,	15,771	13,979	81,516	82,912	39,914	39,135	214,988	239,381
Machinery Glassware	,,	31	38	136	88	162	224	1,425	613
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	48,781	47,939	320,587	347.741	134,709	128,335	877,030	948,281
Plate and Sheet Glass	,,	90,486	112,391	642,822	760,177	137,066	155,300	953,692	1,021,971
Optical Glass (other than worked Elements, e.g. Lenses)	,,	2	1	41	13	348	172	3,304	1,511
Bottles and Jars	gross	102,661	124,063	728,147	834,983	62,532	79,975	457,129	507,560
Glass and Glassware not elsewhere specified ...	cwts.	3,159	2,297	13,871	18,701	8,610	6,472	41,859	49,649
Total Value	£	—	—	—	—	389,594	417,472	2,597,173	2,819,444

EXPORTS OF GLASS AND GLASSWARE (BRITISH PRODUCTS).

		QUANTITIES.				VALUE.			
		Month ended 31st July.		Seven months ended 31st July.		Month ended 31st July.		Seven months ended 31st July.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)...	value	—	—	—	—	4,327	7,573	38,935	40,731
Tubing and Rod for all purposes	cwts.	469	328	2,019	2,879	2,623	2,101	14,042	17,132
Illuminating Glassware	,,	470	619	3,626	3,411	4,027	5,551	33,851	30,040
Machinery Glassware	,,	407	194	2,622	1,472	2,779	1,475	18,516	11,469
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	3,090	3,525	19,170	16,961	29,666	32,713	171,109	165,726
Plate and Sheet	,,	73,748	82,783	484,903	536,396	137,878	159,778	941,973	965,455
Optical (other than worked Elements, e.g. Lenses)	,,	5	3	69	35	92	112	1,660	915
Bottles and Jars	gross	26,888	31,559	190,560	170,374	24,383	27,219	190,732	164,644
Manufactures, not elsewhere specified	cwts.	395	958	4,480	5,117	2,708	6,210	25,497	30,581
Total Value	£	—	—	—	—	208,488	242,732	1,436,315	1,426,693

EXPORTS OF GLASS AND GLASSWARE (FOREIGN AND COLONIAL MERCHANDISE).

		QUANTITIES.				VALUE.			
		Month ended 31st July.		Seven months ended 31st July.		Month ended 31st July.		Seven months ended 31st July.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)...	value	—	—	—	—	469	451	3,765	3,109
Glass Tubing and Rod for all purposes ...	cwts.	—	—	10	8	7	8	141	110
Illuminating Glassware	,,	131	263	929	1,121	1,005	2,065	7,283	9,239
Machinery Glassware	,,	—	—	1	4	—	15	26	100
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	836	867	4,977	4,915	5,729	6,598	31,471	32,144
Plate and Sheet	,,	154	795	1,798	3,441	237	506	2,642	3,419
Optical Glass (other than worked Elements, e.g. Lenses)	,,	2	—	33	25	38	—	280	263
Bottles and Jars	gross	6,631	1,957	14,615	10,357	4,490	1,829	12,777	9,104
Glass and Glassware not elsewhere specified ...	cwts.	26	73	479	331	130	681	2,800	1,842
Total Value	£	—	—	—	—	12,105	12,153	61,185	59,330

Opening of the Glassmakers' Camp.

Opposite the Royal Mint and the Tower of London.

In officially declaring open for trade the large showrooms and warehouses at 98, Mansell Street (opposite the Royal Mint and the Tower of London), which have been aptly described as a "Glassmakers' Camp," Mr. E. A. Hailwood, managing director of Messrs. Ackroyd & Best, Ltd., of Morley, near Leeds, said that it had been a source of great satisfaction and pleasure to hear the many exclamations and expressions of agreeable surprise on the part of those buyers of general glassware, contractors, electric light fitters, glass factors and others present at the opening. They had walked through the many rooms at this "Camp" and seen the large variety of beautiful and utilitarian glassware, and the large range of opal, three-ply, clear and coloured shades, bowls, units, globes, vases, etc., on show, every piece of which he was pleased to say had from beginning to end been made at Morley, near Leeds.

He could assure those present that the mountains of packing cases and cardboard cartons to be seen on every hand were not a mere bluff; every one was filled with glassware. The firm had hoped to have unpacked and displayed still more of the contents of these cases, but the Morley Works had, so to speak, simply snowed the "Camp" under with daily consignments of glassware. They hoped, during the next few weeks, to re-arrange some of the showrooms in order to display even more of their stock. They did not, however, intend to open out all the multitude of cases, but would keep much of the glassware ready packed in the strong and practical cardboard cases (which were made at their own works and which were fitted with cardboard guides and cushions to prevent breakage) and to hand these out ready packed to their London and district customers. Of course, those purchasers who preferred to have the boxes opened and the contents examined before taking delivery would be quite free to do so.

DIFFICULTIES OF THE TRADE.

During the War the firm of Ackroyd & Best, Limited, were engaged upon making heat-resisting and chemical glassware, and it was only since hostilities had ceased that the firm had developed the making of illuminating and decorative glass ware. They were new to the job, and had been appalled at the enormous variety of shapes and sizes of glassware needed to meet the requirements of the illuminating trade. The making of the huge variety of moulds and the producing of samples from such moulds had been a gigantic task, especially as it had been so difficult to convince buyers that, here in England, there was a new works willing to make, and capable of making, almost anything in the glass line, exclusive of sheet glass and ordinary bottles and jars.

The result has been that the firm of Ackroyd & Best, Ltd., had very rarely been supported with substantial orders such as would give their workers a reasonable chance of getting the moulds well hot, and the men into the stride and swing necessary for the production of good glassware. In the absence of firm orders they had had to grope their way, and in many cases keep their men together by working to stock; hence some of the large stocks being displayed that day. In other cases, moulds have had to be made on speculation, and test pieces blown and decorated to show potential customers the size and shape of mould and type of decoration. Naturally these test pieces were not such good examples as would be available from quantities manufactured to the definite orders which it is was hoped that "display" would command from London and district buyers.

As the gangs of glass blowers are now getting well settled down to their work he was certain that Ackroyd & Best would in the near future further surprise British buyers by the increased variety and originality of "Hailglassware," which they would turn out at Morley. He had recently expressed surprise to the officials of one large electric lamp concern at the vast amount of British money which had, year by year, gone abroad in the purchase of glassware, and especially illuminating glassware. He was pathetically told that the chiefs of several concerns had in vain searched Britain over for someone to take up the manufacture of that particular type. He (Mr. Hailwood) could only say that not one of these pilgrims had reached the works of Messrs. Ackroyd & Best at Morley, near Leeds, notwithstanding the fact that the firm had been advertising in most of the trade journals and many daily papers, and had maintained a substantial stand at the first exhibition at Wembley, and also had travellers showing stocks in properly equipped stockrooms at most of the big cities in the British Isles. Yet these patriotic people had failed to see these conspicuous indications of the ability and willingness of Messrs. Ackroyd & Best to meet British requirements. He suspected the true answer was, that the buying departments of many of the large concerns were obsessed with obtaining big and unreasonable profits which they could not expect to get from British makers on account of their heavy taxation and other obligations. The buyers deliberately shut their eyes and ears to the displays and pleas of British manufacturers in order to whine at the alleged lamentable backwardness of British makers, meanwhile squeezing down foreign prices and keeping their own selling prices high to reap large profits for their departments, and so receive the applause of their chiefs.

Mr. Hailwood hoped that the exhibitions now before the eyes of those present, and further samples of which could be seen at the show rooms, at 32, Shaftesbury Avenue, London, or at the works at Morley, near Leeds, would once and for all give the lie to the atrocious tale that suppliers of good and artistic "British made" illuminating and fancy glassware could not be obtained in this country. Ackroyd & Best had decided to grade their glassware. Certain patterns would be made by mass production at prices to meet foreign competition, even if it involved for the time being the selling at "no profit." Other patterns would be reserved for better class trade, and reasonable prices asked. Good discounts would be reserved or given to the trade. Provided the London trade supported them, it was not their intention to set out to *retail* standard lines of "Hailglassware." They hoped to work *through the trade*; they were advertising vigorously their brand of "Hailglassware," and they pleaded with the public to demand this British article and to look for the name "Hailglass," which would be stamped on each piece. They hoped that the public would inform them of instances where this brand was refused, and they, Ackroyd & Best, Limited, would be pleased to put such people in touch with the nearest retailers of "Hailglassware."

A GAMBLER'S LAST THROW.

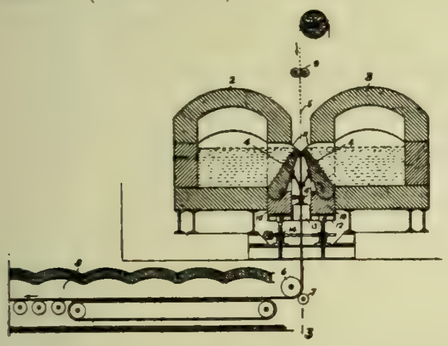
There was, of course, special commercial glassware to suit machines, instruments, etc., which often could only be handled direct with the maker of such machines. He looked to these makers to communicate direct with the firm's head office at Morley, or at one of Ackroyd & Best's branches. He added that the firm were issuing a very beautiful catalogue showing coloured pictures of a large range of their glassware, and this catalogue would be supplied to the trade. In conclusion, Mr. Hailwood stated that he hoped that he had not during the course of his speech, nor in any of the firm's advertisements, given offence to any of the trade; he had not intended to be offensive, and he trusted that the difficulties under which the glass trade had had to work, coupled with the strange lack of sympathy which the President of the Board of Trade had displayed to the industry, and the difficulties which the Board of Trade had opposed to the carrying out of Mr. Baldwin's promises to the glass trade, were sufficient excuse for anything said by anyone who found himself involved in such a difficult and thankless industry mainly because of Government promises which had not been carried out.

The opening of that glassmakers' "camp" was more or less in the nature of a "gambler's last throw," and he trusted that for the good of the country it would not be a failure. The glass trade was already almost dead, and under prevailing conditions he thought that if hostilities should break out on any future occasion it would be a case of God help England if its glass industry was extinct. He then declared the showroom and warehouses at 98, Mansell Street opened for business. This statement was received with prolonged applause by the large company present at the ceremony.

United States Patents.

GRANTED JULY 13th, 1926.

1,592,180.—**Apparatus for Making Wire Glass.** Walter Cox and Arno Shuman, Philadelphia, Pa., assignors to Pennsylvania Wire Glass Company, Philadelphia, Pa., a Corporation of New Jersey. Filed December 18, 1920. Serial No. 431,586. 6 Claims. (Cl. 49—32.)



3. Apparatus for making wire glass comprising the combination of a glass tank furnace, confronting dams over which confluent streams of glass flow from the tank, means for pivotally adjusting the dams to regulate the confluence of the flow, and devices for passing wire netting between the dams and through the confluence of the streams, substantially as described.

1,592,228. **Process for Making Corrugated Wire Glass.** Arno Shuman, Philadelphia, Pa., assignor to Pennsylvania Wire Glass Company, Philadelpia, Pa., a Corporation of New Jersey. Filed February 11, 1926. Serial No. 87,480. 2 Claims. (Cl. 49—32.)

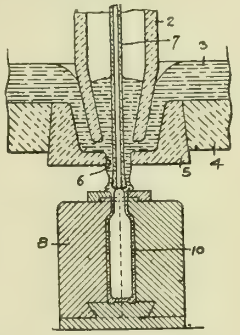
1. The process of making wire glass which consists in rolling a plain sheet of glass with wire mesh embedded therein, and, while the interior portion of the sheet is sufficiently plastic by heat to permit twists of the mesh to stretch and while the exterior of sheet is sufficiently solid by cooling upon bending to retain its form, simultaneously corrugating said sheet and mesh in part by laying it upon a corrugated table and in part by pressing it between corrugated surfaces.

1,592,253. **Feeding Mechanism for Glass-Moulding Machines.** Clyde A. Beeth, Rochester, N.Y. Filed May 11, 1922. Serial No. 560,194. 19 Claims. (Cl. 49—55.)

1. A feeding mechanism for glass molding machines comprising a movably mounted spout for delivering molten glass into the mold of a blowing machine, a weighing mechanism for delivering glass to the spout, and mechanism for controlling the movement of the spout controlled by said weighing mechanism.

1,592,299. **Method and Apparatus for Making Blown Glassware.** George E. Howard, Butler, Pa., assignor, by mesne assignments, to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed July 8, 1921. Serial No. 483,234. 55 Claims. (Cl. 49—5.)

6. The method of making blown glassware that comprises causing a mass of molten glass to issue in a suspended mass from a downwardly opening discharge orifice, directing fluid under pressure through the said orifice into the interior of the said mass while the said mass is still attached to the parent body, and simultaneously applying an elongating impulse to the said mass from above, thereby assisting in forcing the glass through the said orifice.



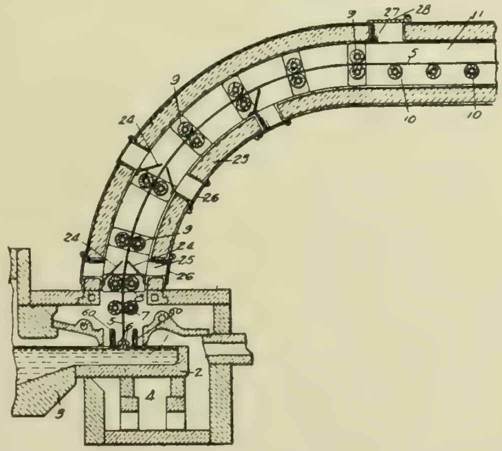
1,592,336. **Glass-Melting Container.** James Bryce, Pittsburgh, Pa. Filed January 30, 1923. Serial No. 615,828. 2 Claims. (Cl. 49—60.)

1. A container or receptable in which to fuse the ingredients entering into a glass batch, which container is formed from a ferrous alloy containing a percentage of chromium such that oxidation of the surfaces of the container in contact with the ingredients during and after fusion thereof will be negligible.

1,592,429. **Process of Treating Glass and the Product Thereof.** Charles A. Kraus, Worcester, Mass. Filed June 5, 1924. Serial No. 718,015 6 Claims. (Cl. 41—20.)

1. The process of treating glass, characterised by substitution in a delimited region in glass, for ions normally present in the glass, of ions of different atomic number, in quantity so restricted as to be normally invisible, but in quantity sufficient to be developable to visibility by differential condensation of liquid upon the glass.

1,592,444. **Drawing Sheet Glass.** Joseph P. Crowley, Toledo, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed March 22, 1924. Serial No. 700,998. 14 Claims. (Cl. 49—17.)



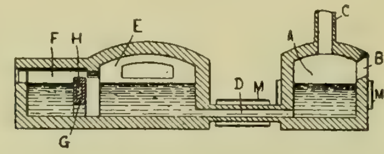
1. In the art of producing sheet glass, the process of drawing the sheet from its molten source in a vertical

direction, until substantially set, and then bending the sheet into another plane along an arc of such curvature that the bending strains will not exceed the elastic limit of the sheet.

6. Apparatus for making sheet glass, comprising a receptacle containing a pool of molten glass, and means for drawing a continuous sheet of glass vertically therefrom and carrying the sheet into another plane, comprising means for drawing the sheet vertically from the pool until set in flat sheet form, and means for gradually bending the flat sheet against its own elasticity into another plane.

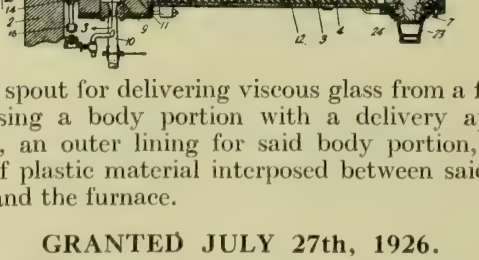
GRANTED JULY 20th, 1926.

1,593,054.—**Furnace for Glass Manufacture.** Pierre Arbeit, Paris, France, assignor to Manufactures des Glaces & Produits Chimiques de St. Gobain, Chauny & Cirey, Paris, France, a Corporation of France. Filed November 19, 1924. Serial No. 750,909, and in France December 6, 1923. 4 Claims. (Cl. 49—54.)



1. In a continuously operating glass-making furnace, in combination, independent melting and refining chambers arranged in separate blocks of masonry, means for separately heating the melting and refining chambers, passage means connecting the melting and refining chambers, and electrical means for independently heating the passage means and controlling the flow of glass therethrough for the purpose described.

1,593,290.—**Apparatus for Delivering Viscous Glass.** Edwin P. Corbett, Columbus, Ohio, assignor to Hartford-Empire Company, a Corporation of Delaware. Filed November 15, 1924. Serial No. 750,213. 11 Claims. (Cl. 49—55.)



1. A spout for delivering viscous glass from a furnace comprising a body portion with a delivery aperture therein, an outer lining for said body portion, and a layer of plastic material interposed between said outer lining and the furnace.

GRANTED JULY 27th, 1926.

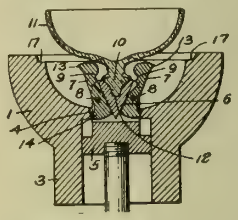
1,593,566. **Lining for Furnaces and the Like.** Clarence P. Byrnes, Sewickley, Pa. Filed October 2, 1924. Serial No. 741,120. 9 Claims. (Cl. 266—43.)

1. A furnace having a built-up wall formed of blocks, at least part of said blocks having a fused silica face portion adapted to contact with fused bath materials contained in said furnace.

1,593,567.—**Glass Shaping or Feeding.** Clarence P. Byrnes, Sewickley, Pa. Filed October 29, 1925. Serial No. 65,554. 14 Claims. (Cl. 49—17.)

1. In apparatus for shaping or feeding glass a device having a surface of fused silica arranged to contact with the moving glass.

1,593,614. **Press Mold for Glass Articles.** George E. Zeiler, Pittsburgh, Pa. Filed April 6, 1922. Serial No. 550,003. 7 Claims. (Cl. 49—72.)



1. A mold comprising a member for forming the body portion of an article and a collapsible member movable with respect thereto for forming a necked-in extension on said body portion and for raising said article from said mold.

3. A mold comprising a main body portion of hollow construction having an axial opening therein and a supplementary collapsible portion movably mounted in said opening for co-operation with said body portion.

1,593,627. **Method of and Apparatus for Annealing and Cooling Sheet Glass.** Lawrence A. Gessner, Jeannette, Pa., assignor to Window Glass Machine Company, Pittsburgh, Pa., a Corporation of New Jersey. Filed November 3, 1923. Serial No. 672,530. 16 Claims. (Cl. 49—47.)

1. In the method of making substantially flat sheet glass, the steps consisting in passing sheet glass through a lehr, passing heated gaseous fluid through the lehr in the same direction as the travel of the glass, and maintaining a substantially smooth and continuous flow of the gaseous fluid along the under surface of the glass in such adjusted amounts as will substantially prevent warping or bowing of the glass in the lehr, substantially as described.

1,593,632. **Method and Apparatus for Annealing and Cooling Sheet Glass.** John Hartzell, Arnold, Pa., assignor to Window Glass Machine Company, Pittsburgh, Pa., a Corporation of New Jersey. Filed February 16, 1924. Serial No. 693,249. Renewed January 2, 1926. 17 Claims. (Cl. 49—47.)

1. In the method of annealing and cooling sheet glass the steps consisting in supplying flat hot glass to a horizontally extending lehr tunnel, supplying streams of heated gases to the tunnel above and below the glass level adjacent the end of the tunnel where the glass enters and permitting the streams to travel through the tunnel in contact with the glass, and abstracting heat from the upper stream in amounts sufficient to substantially equalise the rate of heat loss from the two faces of the glass, substantially as described.

1,593,756. Device for Feeding Materials into Glass Furnaces. John Debnar, Blairsville, Pa. Filed February 24, 1926. Serial No. 90,306. 12 Claims. (Cl. 214—26.)

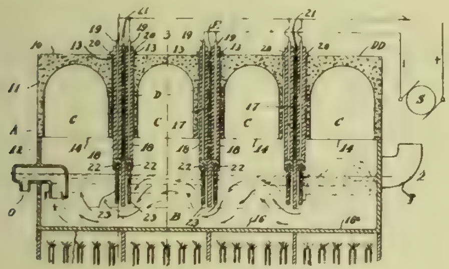
1. In a device for feeding materials to glass furnaces, a portable carriage movable across the front walls of a battery of glass furnaces, a plurality of hoppers on the carriage, a ladle selectively positioned relative to the hoppers and movable through the furnace door openings, each hopper having a discharge opening at its lower end, a sliding gate valve for each opening, and independent means for operating each gate valve.

1,593,997. Glass Machinery. Clarence W. Avery and Wenzel G. Vesey, Detroit, Mich., assignors to Ford Motor Company, Detroit, Mich., a Corporation of Delaware. Filed February 24, 1922. Serial No. 538,994. 2 Claims. (Cl. 51—110.)

1. In a device of the class described including a work carrying table, an abrading device associated therewith, electrical means for driving the abrading devices, means for feeding an abrasive substance to the work on the table, and means included in the driving device circuit for automatically varying the abrasive substance supplied in proportion to the current passing through said circuit whereby the efficiency of the abrading device may be maintained to a substantially constant predetermined amount.

GRANTED AUGUST 3rd, 1926.

1,594,496. Electrofining Glass Furnace. Walter G. Clark, New York, N.Y. Filed April 6, 1920. Serial No. 371,699. 7 Claims. (Cl. 204—64.)



1. The combination in a furnace of the class described having a fining zone, of means for maintaining the glass in molten condition in the fining zone by heat other than electric, and means located within the molten mass of glass within the fining zone for introducing electric current through said glass, said last means being adjustable so as to vary the amount of electric current passing through said glass.

1,594,557. Fire-Polishing Apparatus. William L. Proeger, Toledo, Ohio, assignor to The Libbey Glass Manufacturing Company, a Corporation of Ohio. Filed April 28, 1924. Serial No. 709,360. 17 Claims. (Cl. 49—58.)

1. A table adapted to support an inverted article of hollow glassware, means to rotate the table about a vertical axis, and a burner declined at an approximately 45° angle to the horizontal and adapted to play a flame against substantially all of one side of an article on the table.

GRANTED AUGUST 10th, 1926.

1,595,103.—Method of and Apparatus for Treating Molten Materials. Charles B. Kingsley, Elizabeth, Pa., assignor to Mississippi Glass Company, a Corporation of New York. Filed March 21, 1924. Serial No. 700,751. 14 Claims. (Cl. 49—45.)

1. In connection with a glass melting furnace, a chamber having walls of a material of low heat conductivity and whose heat conductivity varies progressively through the length thereof, and said walls comprising means for passing glass through said chamber.

7. In the manufacture of glass the process comprising passing molten glass in sheets between movable walls of gradually increasing heat conductivity, comprising endless belts and moving said walls and sheets synchronously.

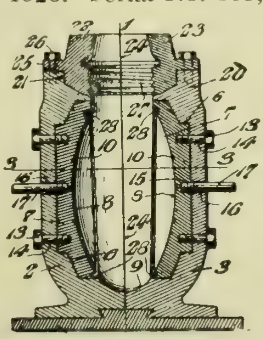
1,595,125.—Lehr for Continuous Sheet Glass. James B. Small, Charleston, W. Va., assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed July 14, 1924. Serial No. 725,851. 8 Claims. (Cl. 49—47.)

1. In combination with a lehr and a conveyor for carrying a continuous strip of glass therethrough, a plurality of heating elements positioned at spaced locations in the lehr, and heat radiating and deflecting elements positioned between the heating elements and the sheet.

1,595,358.—Process of Making Glass. Charles E. Parsons, New York, N.Y., assignor to Metal Research Corporation, New York, N.Y., a Corporation of Delaware. Filed September 19, 1925. Serial No. 57,463. 3 Claims. (Cl. 106—36.3.)

1. The process of making glass in a blast furnace which consists in providing a charge of blast furnace slag mixed with an alkali metal chloride and carbonaceous material; igniting said charge; and continuing the melting of the same until an iron free glass consisting essentially of calcium-sodium silicate is produced.

1,595,773.—Glass Mold. Edgar A. Gillinder, Philadelphia, Pa., assignor to Gillinder & Sons, Inc., Philadelphia, Pa., a Corporation of Pennsylvania. Filed May 1, 1926. Serial No. 105,939. 2 Claims. (Cl. 49—70.)



1. In a mould of the character stated, a bottom plate, a pair of hinged mold members, having body molding portions and upper neck molding portions, and having opposed inner recesses in the inner surfaces of the body portions thereof, a pair of opposed die plates having opposed inner concaved die surfaces seated in said recesses, means for securing said die plates in said recesses, and a pair of semi-circular upper thread dies detachably secured to the neck portion of said mold members.

1,595,912.—**Method of Annealing and Cooling Sheet Glass.** William L. Monro, Pittsburgh, Pa., assignor to Window Glass Machine Company, Pittsburgh, Pa., a Corporation of New Jersey. Filed February 12, 1924. Serial No. 692,247. 5 Claims. (Cl. 49—89.)

2. In the method of producing substantially flat sheet glass, the steps consisting in supplying flat hot glass to a horizontally extending lehr tunnel, supplying streams of heated gases to the tunnel above and below the glass level adjacent one end of the tunnel and permitting streams thereof to travel through the tunnel in contact with the glass, and adding heat to the lower stream in adjusted amounts sufficient to compensate for the difference in temperature and velocity of the lower stream as compared with the upper stream so as to prevent warping of the sheet and insure the production of substantially flat sheet glass, substantially as described.

5. In the method of producing substantially flat sheet glass, the steps consisting in supplying flat hot glass from a heated flattening oven to a horizontally extending lehr tunnel connected to the flattening oven, permitting gases to flow from the oven through the tunnel in streams above and below the glass level, and adding heat to the lower stream in adjusted amounts sufficient to compensate for the difference in temperature and velocity of the lower stream as compared with the upper stream and thereby prevent warping or bowing of the glass sheet, thus insuring the production of substantially flat sheet glass, substantially as described.

◆

BRITISH PATENTS.

The following abstracts are taken from the Illustrated Official Journal of Patents with the special permission of the Controller of H.M. Stationery Office.

Printed copies of the full specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C., price 1/- each.

252,371.—**Glass Manufacture.** Hartford-Empire Co., 333, Homestead Avenue, Hartford, Connecticut, U.S.A.—(Assignees of Canfield, R. W., 28, Bishop Road, West Hartford, Connecticut, U.S.A.) May 18, 1926, No. 12717. Convention date, May 19, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)

Blowing.—Relates to the manufacture of hollow blown glassware having thin walls, such as electric lamp bulbs and tumblers. The principal feature of the invention consists in suspending a glass blank by its marginal portion and allowing it to distend downwardly, whilst it is being heated, the distension being opposed by gaseous pressure in order to regulate the elongation and lateral expansion of the parison. Apparatus for carrying out this method of parison formation is shown in Figs. 1 and 4 and comprises a combined press and blow head 42, a ring mould 13, a blank mould 20, a finishing mould 104, and burners 100 the flames from which supply the gaseous pressure for regulating the formation of the parison.

Ring and blank moulds.—The ring mould is supported in a circular opening in a table 3, and the two halves 13 of the mould are pivoted to a gear ring 5 which is mounted on ball bearings 6. The gear ring can be rotated by means of a crank handle 16 through a bevel gear 14. The blank mould is carried by an arm 17 pivoted on a bracket 18 below the table 3, and consists of a casing 20 with a replaceable carbon inset 21 formed with a cavity 23 of the desired shape to mould a charge 24 of glass. The arm 17 swings in a vertical plane, and is held in contact with the ring mould by a hook 25 which engages a pin on a lever 23a. A pin 28, coaxial with the carbon inset, dislodges the blank from the mould when the arm 17 is swung downwards.

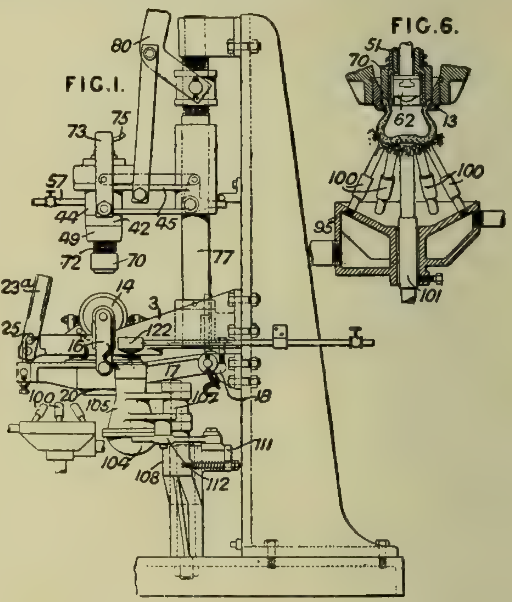


FIG. 1. FIG. 6.

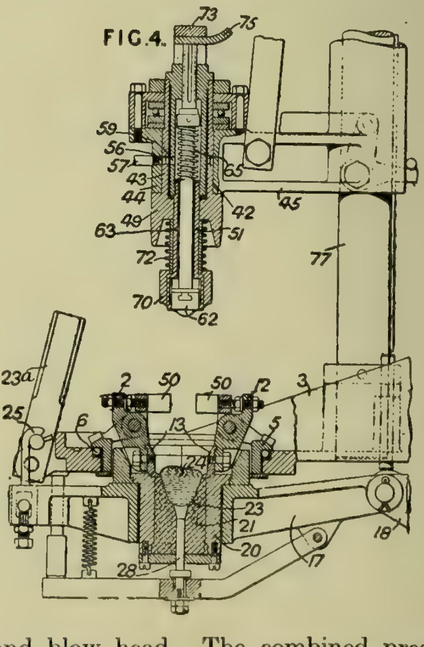


FIG. 4.

Press and blow head.—The combined pressing and blowing mechanism 42 comprises a barrel 43 which is rotatably mounted in a bearing 44 formed at the end of an arm 45. The lower end of the barrel 43 is provided with a head 49 which enters between curved members 50, connected to the upper end of the ring mould holders

12, and locks the mould. The charge of glass 24 is pressed by a plunger 62 carried by a stem 62 which slides within a tube 51 extending coaxially through the barrel 43. Compressed air is supplied to the space between the stem 63 and the tube 51 by means of a pipe 57 and ports 56, 59. A spring 65 withdraws the plunger into the tube during the blowing operation, and a cam 75, which is operated by a pivoted yoke 73, forces the plunger downwards, to the position shown in Fig. 4, for the pressing-operation. A stripper ring 70 surrounds the lower end of the tube 51 and is pressed downwards by a spring 72. The arm 45 which supports the head slides on a vertical post 77, and it is raised and lowered, and also swung horizontally by a lever 80.

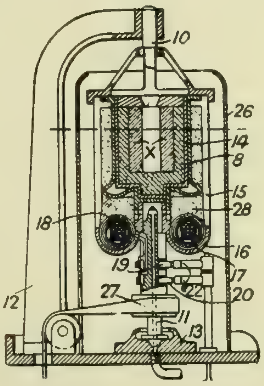
Finishing mould.—The finishing mould 104 consists of two halves 105, Fig. 1, hinged on a pin 107 which is carried on an arm 108 that can be swung horizontally. The mould is opened and closed, and also swung to and from the position beneath the ring mould, by a lever 111 connected by links 112 with the mould halves. The links are formed with notches which engage pins on the mould halves and are kept in engagement with them by springs. By disengaging the links from the pins, the mould halves may be lifted off their pivot 107 for replacement. A sprayer 122 may be provided to cool the mould.

Operation of the machine.—After the blank mould receives a charge of glass, the lever 80 is moved to lower the head 42 and pressure is applied to it to form the charge into a blank. The lever 23a is then moved to release the arm 17 which swings downwardly, and its movement releases the yoke 73 from the cam 75 thus allowing the spring 65 to withdraw the plunger 62 into the tube 51. The operator now rotates the blank by the crank 16 and at the same time he moves under the blank a burner 95 and provided with a number of nozzles 100. Flames from these nozzles play on the blank, as shown in Fig. 6, and reheat it, and the flame from a central burner 101 also tends to retard the sagging of the parison. Air is then blown into the parison to expand it, and blowing and reheating is continued until the parison is of the required shape and wall thickness. The burner is then removed, and when the parison has sagged to the required extent, the finishing mould is closed around it and blowing and rotation is continued until the article attains its final form.

252,747.—**Fused Silica ; Electric Furnaces.** British Thomson-Houston Co., Ltd., Crown House, Aldwych, London.—(Assignees of Thomson, E. ; 22, Monument Avenue, Swampscott, Massachusetts, U.S.A.) June 1, 1926, No. 13847. Convention date, June 1, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Classes 39 (iii) and 56.)

A process for producing transparent, bubble-free, silica consists in fusing the silica, subjecting the plastic mass to the action of centrifugal force in order to segregate the trapped gases in one portion of the mass, allowing the fusion to solidify, and then removing the portion containing the trapped gas. The process may be used also for removing suspended particles from materials forming viscous fusions. Apparatus for carrying out the process comprise a crucible 8, preferably of graphite, built within a resistor 14 and rotatably supported by shafts 10, 11 journaled in a frame 12. The lower shaft 11 is mounted on a thrust bearing 13 and is driven by a belt 27. The resistor 14, which may be of tungsten or molybdenum, forms part of the secondary circuit of a transformer, the circuit being completed by segments 15 forming the exterior casing of the crucible structure and by conductors 16 which surround the iron core 17. The primary windings 18 are connected to the supply curcuit through brushes 22 and slip rings 19, 20 on the shaft 11.

FIG.1.



The structure is surrounded by a shield 26, and heat-insulating material 28 surrounds the resistor 14. Hydrogen or other suitable gas may be conducted through passages in the shaft 11 in order to avoid oxidation of the heater parts or of the fused mass. In a modified construction, the primary elements of the transformer surround the crucible which is covered by a plate of clear quartz to enable the progress of the fusion to be observed. In use, fragments of rock crystal are packed into the crucible and brought to fusion by progressively raising the temperature to about 1700° C. The apparatus is then rotated at about 1500 revolutions or more per minute. The fusion X assumes a cylindrical shape and the gas bubbles or impurities come to the inner surface of the cylinder. Rotation of the apparatus may then be stopped and heating continued so that the cylinder forms into a solid ingot with the frothy mass on top. The upper impure layer of quartz may be cut off by a band of copper or other metal charged with abrasive.

252,956.—**Glass Manufacture.** Golby, F. W., 3, John Street, Bedford Row, London.—(Libbey-Owens Sheet Glass Co., 608, Madison Avenue, Toledo, Ohio, U.S.A.) September 28, 1925, No. 24121. (Class 56.)

Drawing.—Relates to sheet-drawing apparatus, particularly of the Colburn type as described in Specification 114,977, in which knurled rollers engage the edge of the sheet in the meniscus and prevent it from narrowing. According to the invention, the rolls 21 are of such a diameter that they approximate to the normal curvature of the meniscus at the base of the sheet, and they are driven at a speed which is substantially the same as that of the adjacent mass of glass. The rolls 21 are watercooled and are formed with a slightly tapered knurled portion 23 and an incurved reduced end 24. This end is recessed or cupped, as at 25, to restrict the cooling action on the sheet to the extreme edge portions and thus to keep the thickened bead 20 of relatively narrow width. Instead of being cupped, the ends 24 may be conical or torpedo-shaped, and the inclination of the rollers to one another may be adjusted to produce a bead 20 of any desired shape. The sheet is thus formed with a thickened edge which retains sufficient heat to prevent breakage in the lehr while being stiff enough to hold the sheet at its full width.

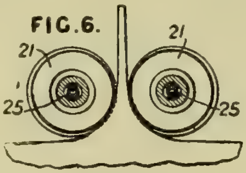


FIG.6.

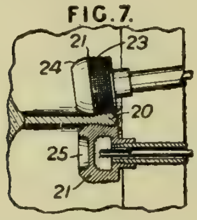


FIG.7.

253,271.—**Regenerator Furnaces ; Bricks.** Moll, H., Rasselstein, near Neuwied-on-Rhine, Germany. April 3, 1925, No. 8941. (Classes 51 (i) and 87 (i).)

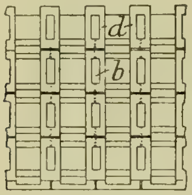


FIG.2.

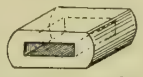


FIG 4.

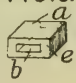


FIG.3.

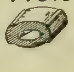


FIG.6

Regenerators.—A checker or gridwork structure for regenerators, air heaters, and the like is formed with hollow bricks, with imperforate end portions placed crosswise in alternate spaced courses with ends abutting, the arrangement being such that the whole of the passage through each brick opens directly to the spaces between the rows of bricks in the course immediately below, while the whole of the imperforate end portions are superposed to form solid brick columns which support the entire weight of the structure. In the illustrated forms, bricks with straight or rounded ends, as shown in Figs. 3, 4, and 6, are arranged at right-angles in alternate courses, as shown in Fig. 2. The size of the hole b in the brick a, Fig. 3, is such that the side walls are half as thick as the brick, thus allowing the solid parts e to rest upon the similar ends of the bricks arranged at right-angles in the course below, to form solid columns. By constructing the bricks with rounded ends, as shown in Fig. 4, wedge-shaped spaces are produced in the columns, thereby exposing a greater area of each brick to the flames, while by adding rounded sides as shown in Fig. 6, the exposed area is increased still more.

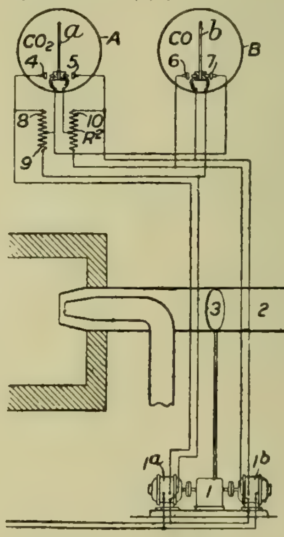
253,494.—**Glass Manufacture.** Bicheroux, M., 48, Nizzaallee, Aachen, Germany.—(Assignee of Reis, L. von ; Herzogenrath, near Aachen, Germany.) May 3, 1926, No. 11600. Convention date, June 11, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. Drawings to Specification. (Class 56.)

Rolling.—A method of avoiding surface defects in plate glass consists in rolling the plates with shallow flutes on one or both surfaces. The plates are made by passing the metal between rollers having circumferential flutings, and the plates so formed are received on conveyer tables which are preferably formed with ribs or flutes at right angles to those on the rollers. Thus the plates make contact with the tables only at small surfaces and transfer of heat from the plates to the tables is minimised.

253,789.—**Ornamenting Glass.** Guedalia, M. M. M. A. De, 54, Rue des Petites Ecuries, Paris. November 5, 1925, No. 27867. Convention date, August 8. (Class 93.)

The appearance of enamelled metal is produced on glass articles by moulding a guillocked pattern on the surface which is to be concealed from view in the finished article and then applying to the same surface a number of colouring and protecting layers. These may consist of (a) one or more coats of colouring material ; (b) a layer of gold, silver, copper, or other metal in liquid, powder, or sheet form ; (c) one or more coats of transparent or opaque varnish. Coloured glass may be employed.

253,844.—**Furnaces.** Reineke, J. H., Weitmar, Bochum, Germany, and Uni-Pressure, Ltd., 701, Salisbury House, London Wall, London. March 25, 1926, No. 8207. (Class 51 (i).)



Air supply, regulating.—A device for regulating the supply of air to furnaces is controlled in dependence on the content of CO_2 and CO in the waste gases in such a manner that if the CO_2 content is less than normal and CO is present the air supply is increased while if the CO_2 content is less than normal and no CO is present it is decreased. A device A for indicating excess or deficiency of CO_2 in the waste gases has a pivoted contact arm a which moves to the left and engages a contact 4 if the CO_2 content is less than normal, short-circuiting a resistance 8. A device B for indicating the presence of CO has a contact arm b which normally lies against a contact 7 when no CO is present short-circuiting a resistance 9. The resistances 8, 9 are in the circuit of a motor 1a which with a motor 1b drives differential gearing 1 of the kind described in Specification 144,304 to operate a valve 3 in the air supply pipe 2, and when these resistances are short-circuited the speed of the motor 1a is increased and the valve closed. If CO is present the contact arm b engages the contact 6 short-circuiting a resistance R^2 in the circuit of the motor 1b thus speeding up this motor and opening the valve 3. If CO_2 is in excess the arm a engages the contact 5, the resistance 10 is short-circuited and the speed of the motor 1b increased, thus opening the valve.

253,866.—**Glass Manufacture.** Soc. Anon. des Manufactures des Glaces et Produits Chimiques, de St. Gobain, Chauny, et Cirey; 1.bis, Place des Saussaies, Paris. April 8, 1926, No. 9300, Convention date, June 20, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)

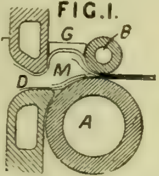


FIG.I.

Rolling.—Relates to sheet-forming apparatus of the kind in which molten glass issuing from a horizontal slot D in the wall of a tank flows into the pass between opposed rollers A, B and is formed into a continuous sheet. According to the invention, the apparatus is so arranged that a reservoir is formed by the space between the wall of the tank, the rollers A, B, and the movable blocks G placed on each side of the slot D. With this arrangement the glass issuing from the slot D does not pass directly between the rollers but accumulates in a mass M. It is stated that by this means, markings in the finished sheet, caused by the passage of the glass through the slot D, are avoided. The roller A may be of greater diameter than the roller B, as shown, or the two rollers may be of the same diameter and a sill interposed between the roller A and the tank wall to form the floor of the reservoir.

253,947.—**Refractory Bricks.** Scheidhauer & Giessing, Akt-.Ges., Bonn, Germany. June 22, 1926, No. 15653. Convention date, June 22. 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 22.)

Refractory substances containing chamotte.—Binding clay in the form of a slip produced by the addition of alkali is added to ground chamotte, and the mixture is moulded and burnt. By burning the chamotte at temperatures higher than usual for example, Seger cone 14 or higher, mixing with the minimum of clay slip, and moulding, under high pressure, blocks are produced which may be built into furnaces, etc., without previous burning.

254,085.—**Glass Windows.** White, A. E., 88, Chancery Lane, London.—(Mississippi Glass Co.; 220, 5th Avenue, New York, U.S.A.) June 9, 1925, No. 14984. (Classes 20 (iii) and 56.)

A sheet of glass has a plain surface and a figured surface formed with two series of parallel V-shaped grooves running diagonally across the sheet. The grooves intersect one another and form parallel rows of pyramids. A sheet, when used as a window pane, deflects part of the light passing through it towards the ceiling.

254,174.—**Glass Manufacture.** General Electric Co., Ltd., Magnet House, Kingsway, London.—(Assignees of Patent Treuhand Ges. für Elektrische Glühlampen; 11, Ehrenbergstrasse, Berlin.) November 24, 1925, No. 29663. Convention date, August 1. (Class 56.)

Production of metal.—A glass to be used for electric insulation purposes, particularly for the parts of electric lamps, contains both potash and soda, and the ratio of potassium oxide to sodium oxide in the glass is within the limits of 7 : 1 and 3 : 1. The percentage composition of a suitable glass is SiO_2, 65; K_2O, 12; Na_2O, 3; and PbO, 20. Another glass has the percentage composition SiO_2, 70; K_2O, 8; Na_2O, 2; B_2O_3, 10; and BaO, 10. Specifications 15963/08 and 219,972 are referred to.

254,175.—**Glass Manufacture.** General Electric Co., Ltd., Magnet House, Kingsway, London.—(Assignees of Patent Treuhand Ges. für Elektrische Glühlampen; 11, Ehrenbergstrasse, Berlin.) November 24, 1925, No. 29664. Convention date, August 1. (Class 56.)

Production of metal.—A glass intended for use as an electrical insulator contains lead oxide and at least 2 per cent. of calcium oxide. A glass suitable for parts of electric lamps has the following percentage composition: SiO_2, 62; Na_2O, 7; K_2O, 8; PbO, 20; and CaO, 3. Specifications 11016/88 and 15963/08 are referred to.

254,270.—**Electric Lamps.** General Electric Co., Ltd., Magnet House, Kingsway, London.—(Assignees of Patent-Treuhand Ges. für Elektrische Glühlampen; 11, Ehrenbergstrasse Berlin.) April 14, 1926, No. 9850. Convention date, June 26, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Classes 39 (ii), 75 (ii), and 93.)

Bulbs; globes.—The silver layers forming reflecting surfaces on the bulbs, etc., of incandescent and arc lamps are rendered heat-proof by coating with a layer of enamel fused thereon.

254,281.—**Glass Manufacture.** Hartford-Empire Co., 333, Homestead Avenue, Hartford, Connecticut, U.S.A.—(Assignees of Peiler, K. E.; 167, Steele Road, West Hartford, Connecticut, U.S.A.) May 25, 1926, No. 13205. Convention date, June 24, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)

Delivering molten metal.—Relates to a feeder of the kind in which a rotary implement extends into the glass in the forehearth for stirring the glass prior to its discharge through an outlet. According to the invention, the implement is a tube surrounding the reciprocating plunger, and means are provided (1) for rotating the tube independently of the means for rotating the plunger, (2) for directing cooling air adjacent to the bearing of the tube, and (3) for facilitating the withdrawal of the tube from its bearing. The molten glass is contained in a forehearth 10, Fig. 1, and is discharged in "gobs" through an outlet 12 by means of a plunger 14, the flow of glass to the outlet being controlled by a tube 16 surrounding the plunger. The tube is rotated to stir the glass in order to obtain uniform temperature and viscosity in the "gobs," and the height of the tube above the outlet is adjusted by means of a crank 20 that raises or lowers the arm 17 by which the tube is supported.

FIG. 1

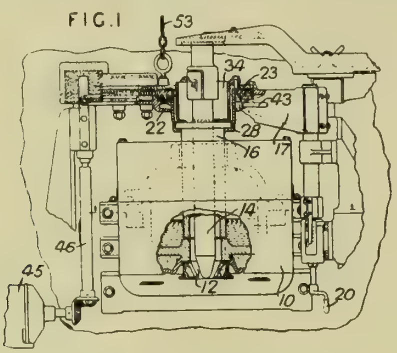
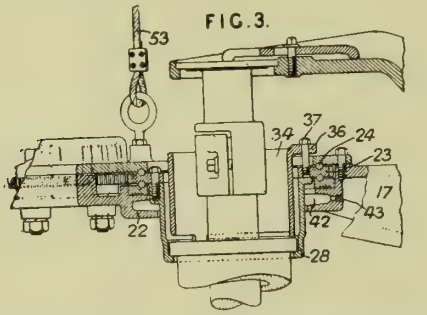


FIG. 3.



The tube is carried by a cylindrical member 28, Fig. 3, the upper edge of which is bolted to a gear ring 23 supported between ball bearings 24 in an annular housing 22. The tube is clamped in the member 28 by another cylindrical member 34 having lugs 36 which are bolted to the gear ring 23. By loosening the bolts 37, the member 34 can be removed, thus enabling the tube 16 to be removed without disturbing its operating mechanism. The gear ring 23 is driven from a shaft 46, Fig. 1, rotated by a motor 45. The speed of the motor can be adjusted to suit the conditions of the glass, and is independent of the means for operating the plunger. The lower portion of the housing 22 is arranged to form an annular chamber 42, Fig. 3, and air is blown into this chamber, through inlets 43 and escapes downwardly through the space between the housing 22 and the member 28. The air thus supplied keeps the bearing cool and is given sufficient force to blow downwards against the cover of the forehearth, thus further protecting the mechanism from the heat radiated from the forehearth. A cable 53, attached to a counter-weight, assists in supporting the weight of the mechanism.

254,316.—**Frosting Glass.** British Thomson-Houston Co., Ltd., Crown House, Aldwych, London.—(Assignees of Pipkin, M.; 3815, Parkdale Avenue, Cleveland Heights, Ohio, U.S.A.) June 23, 1926, No. 15799. Convention date, June 29, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Classes 93, 100 (ii), and 106 (ii).)

Etching, ornamenting, testing strength of glass bulbs.—In the method of frosting electric lamp bulbs and similar thin glass articles on the inside as described in Specification 228,907, in which the bulbs, etc., after being strongly etched, are subjected to the action of a weak etching fluid to strengthen them, the bulbs 25, Fig. 8, are supported over a pipe 24 extending upwardly from a vessel 20 containing the strong etching fluid and the fluid is forced into the bulb by compressed air admitted to the vessel by a pipe 26, surplus fluid returning to the vessel through a funnel 28 and pipe 29. The fluid is kept at a suitable temperature by water circulated in a jacket 21. After being frosted, the bulbs are washed by supporting them over a water pipe 31 and the washed bulbs are then strengthened by a weak etching, the solution for which is supplied by an apparatus similar to that employed in producing the first etching. The strength of the etched bulbs may be tested by supporting them in a clip 10, Fig. 6, hung from a chain 12 and subjecting them to blows from an ivory ball 13 carried by a pivoted rod 14. The ball engages the bulb through a circular opening in a block 16¹. An arcuate scale 17 and pointer 19 serve to indicate the force of the blow. The etching fluids employed consist of ammonium bifluoride, dextrin, barium sulphate, sodium bi-sulphate and water. The results of a number of experiments conducted under different conditions of time, temperature and strength of etching solutions are described.

FIG. 8.

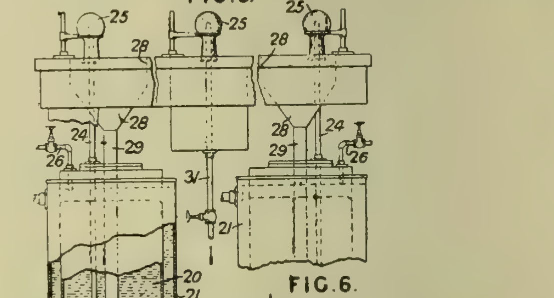
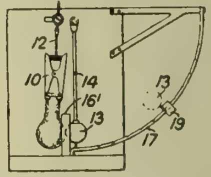


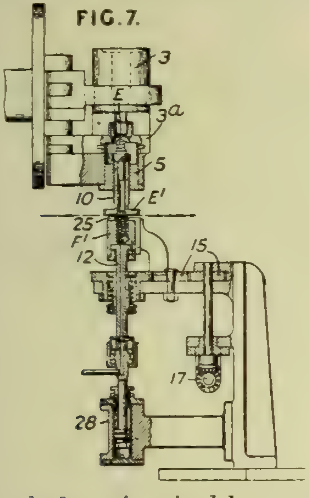
FIG. 6.



251,501.—**Glass Manufacture.**—Tennant, W. J., 111, Hatton Garden, London.—(Lockwood, L. V.; 165, Broadway, New York, U.S.A.) Aug. 20, 1925, No. 20917. (Class 56.)

Blowing; forming screw-necked bottles.—Relates to mechanism for forming a screw thread in the mouth of a parison as it is being formed in a bottle-blowing machine. The mechanism is shown applied to a rotary-table turnover machine in which each blank mould 3 has associated with it a mandrel E having a threaded tip. The shank 10 of the mandrel is threaded and works through a nut 5 carried by the mould. Thus by turning the shank 10, the mandrel may be screwed into or out of the ring mould 3a. In accordance with the present invention, the lower end of each mandrel shank 10 is formed with a pinion or collar E¹ which has its underside provided with clutch lugs 25. These lugs are adapted to engage a clutch member F¹ which is carried at the upper end of a rod 12. The rod is raised or lowered by a pneumatic cylinder 28, and it is rotated by a shaft 17 through the medium of gear wheels 15.

FIG. 7.



In operation, a shaft 12 is raised by a cylinder 28 and the rotation of the shaft screws the mandrel E into the ring mould. After the mould is charged with metal, it is carried by the rotation of the machine to another station where the mandrel is screwed out of the ring mould by another mechanism similar to that shown, thus leaving the mouth of the parison formed with an internal screw. The unscrewing of the mandrel is started, however, while the mould is travelling between the two stations, by a toothed segment which engages the pinion E^1.

* * *

Latest British Patents.

Applications.

18046—July 19, 1926. (Hungary, November 10, 1925.) J. Linner. Bottle stoppers.

18127—July 20, 1926. Holophane, Ltd. (Rolph). Prismatic reflectors.

18229—July 21, 1926. J. Askey. Means for securing cap closures on bottles, etc.

18303—July 22, 1926. A. R. Hurley. Closures for bottles, etc.

18323—July 22, 1926. (United States, January 13, 1925.) C. B. Wisner. Rotary furnaces.

18324—July 22, 1926. (United States, January 13, 1925.) C. B. Wisner. Rotary furnaces.

18379—July 23, 1926. (Belgium, July 23, 1925.) R. Dehaudschutter. Machine for making blown glasses, etc.

18395—July 23, 1926. A. Hobson J. Hobson & Son . Wicker casings for glass bottles.

18438—July 23, 1926. A. A. Beard. F. Miller. Milk bottles.

18448—July 23, 1926. R. H. B. Lamprey. South Metropolitan Gas Co. Manufacture of refractories.

18614—July 26, 1926. (United States, July 29, 1925.) R. M. Withycombe. Process for attaching rubber to metal, glass, etc.

18616—July 26, 1926. (Germany, July 27, 1925.) L. von Reis. Devices for cutting sheet glass.

18725—July 27, 1926. S. H. Beeton. Crown cork attachment.

19156—August 3, 1926. T. R. Wollaston. Means for discharging ash, etc., from gas-producers.

19350—August 5, 1926. F. H. Ward, W. R. Ward. Devices for removing closures from bottles, etc.

19570—August 7, 1926. F. E. V. Beanes. Bottles, etc., stoppers therefor.

19640—August 9, 1926. A. H. Day. Apparatus for filling milk bottles.

19731—August 10, 1926. F. E. V. Beanes. Bottles, etc., and stoppers therefor.

19733—August 10, 1926. (United States, August 26, 1925.) Crown Cork and Seal Co. Bottling machines.

19762—August 10, 1926. G. B. Riley. Reinforced glass.

19776—August 11, 1926. J. C. D. Atkinson, J. R. Atkinson. Means of preventing pilfering of spirits, etc., from bottles.

19907—August 12, 1926. (France, August 27, 1925.) Manufactures des Glaces et Produits Chimiques de St. Gobain. Chauny, et Cirey, S. Stretching glass.

19924—August 12, 1926. W. Cappmael. (I. G. Farbenindustrie Akt. Ges.) Manufacture of hollow bodies from quartz, etc.

19944—August 12, 1926. (Spain, August 12, 1925.) A. T. Mezquita. Stopper for bottles, etc.

20152—August 16, 1926. A. J. Bevan. Hygienic milk bottle.

20178—August 16, 1926. British Sure Seal Co., Ltd. W. A. Stephens. Closure devices for bottles, etc.

20256—August 17, 1926. (Germany, October 13, 1925.) C. H. F. Muller (firm of). Attachment of iron to glass.

20290—August 17, 1926. (United States, November 9, 1925.) Plibrico Jointless Firebrick Co. Furnace settings.

20314—August 17, 1926. (United States, August 24, 1925.) American Optical Co. Multifocal ophthalmic lenses.

20424—August 19, 1926. F. E. V. Beanes. Bottles, etc., and stoppers therefor.

20464—August 19, 1926. A. E. Taylor. Closure for bottles, etc.

20558—August 20, 1926. R. E. Gray. Bottle stopper.

20578—August 20, 1926. O. Muller-Tanneck. Roof for industrial ovens and furnaces.

20582—August 20, 1926. V. S. Ruff. Device for removing sealing discs of milk bottles, etc.

20649—August 21, 1926. F. E. V. Beanes. Bottles, etc., and stoppers therefor.

Specifications Accepted.

231186—March 19, 1924. L. Chavanne. Heat interchanging apparatus and process.

242607—November 10, 1924. Open Hearth Combustion Co. Method of construction of open-hearth furnace walls.

245450—January 3, 1925. E. Wessely, N. Starrach and F. Schmied. Apparatus and processes for drawing glass.

247552—February 10, 1925. E. Maingonnat. Closing means for jars, bottles, and the like.

248369—February 25, 1925. Pfalziache Chamotte und Thonwerke (Schiffer & Kircher) Akt. Ges. Process for the manufacture of refractory bricks.

249125—March 13, 1925. C. Perdrisat. Apparatus for producing a combustible gas.

249534—March 19, 1924. (Divided application on 231186.) L. Chavanne. Heat interchanging apparatus and process.

249536—March 19, 1924. (Divided application on 231186.) L. Chavanne. Heat interchanging apparatus.

250536—April 10, 1925. Soc. Anon. des Manufactures des Glaces et Produits Chimiques de St. Gobain, Chauny et Cirey. Process and apparatus for fining glass.

251276—April 24, 1925. Metallwerk Wasungen Ges. Closing devices for bottles.

255206—June 20, 1925. C. D. Gabell and C. D. Gabell, Ltd. Closing swing-stopper bottles.

255281—October 10, 1925. J. Y. Johnson. (Badische Anilin & Soda Fabrik.) Heating the blast for furnaces, producers, and the like.

255329—January 15, 1926. L. Rainchon. Gas producer furnaces.

255395—April 26, 1926. G. E. Hider. Steam or other fluid jet blowers for gas-producers and like purposes.

255632—July 10, 1925. (Cognate Application, 23314/25.) T. Sutcliffe. Machines for fixing caps on bottles, jars, and containers.

255678—September 17, 1925. Leyland & Birmingham Rubber Co., Ltd., and G. Anderson. Stoppers for bottles and the like.

255782—April 19, 1926. J. B. Sanders. Non-refillable bottle.
255927—April 27, 1925. T. F. Pearson. Machines for the manufacture of hollow glassware.
256021—June 27, 1925. A. J. H. Haddan (Celite Co.). Refractory heat insulating material and process of manufacturing same.
256040—July 17, 1925. A. E. White. (Mississippi Glass Co.) Method of and apparatus for annealing glass.
256095—November 3, 1925. G. Steuler. Hot-blast stoves and regenerators.
256170—July 21, 1925. A. Anders Pindstofte's Maskinfabrik Aktieselskab. Bottle transferring apparatus for bottle machinery.
256326—May 7, 1925. S. Oyama. Caps or closures for bottles.
256507—March 5, 1926. E. C. R. Marks. (Bartsch, Quilitz & Co. Akt. Ges.) Seals for bottles or similar vessels.
256,661—April 7, 1925. E. C. R. Marks. (Liptak Fire Brick Arch Co.) Furnace wall.
256737—June 5, 1925. Chance Bros. & Co., Ltd. P. V. W. Gell, C. E. Gould, W. M. Hampton and H. S. Martin. Colourless Crookes glass.

Open to Public Inspection.

255893—July 23, 1925. R. Dehandschutter. Machine for making blown glasses or goblets for cutting.
255899—July 27, 1925. L. von Reis. Methods and devices for cutting sheet glass.
256170—July 31, 1925. Anders A. Pindstofte's Maskinfabrik Aktienselskab. Bottle transferring apparatus for bottle machinery.
256188—August 1, 1925. Patent—Treuhand—Ges Fur Elektrische Gluhlampen. Insulators formed from glass.
256189—August 1, 1925. Patent—Treuhand—Ges Fur Elektrische Gluhlampen. Method of producing glass suited particularly for insulating purposes.
256227—July 29, 1925. R. M. Withycombe. Process for attaching rubber to metal, glass, and other substances.
256975—August 11, 1925. Dr. S. Loewe. Process of making vacuum tubes.
256984—August 12, 1925. A. T. Mezquita. Stopper for bottles, flasks and like containers.

Patents, Trade Marks, Inventions.—Advice, Handbook and Consultations free. King's Patent Agency, Ltd., Director B. T. King, C.I.M.E.; Regd. Patent Agent, G.B., U.S., and Canada, 146a, Queen Victoria Street, E.C.4, and 6, Quality Court (near Patent Office), London, W.C. 39 years' references. 'Phone: Cent. 682.

Patents and Designs Acts, 1907 and 1919. The Proprietors of British Patent No. 186569 are prepared to sell the patent or to licence British Manufacturers to work thereunder. It relates to a process and apparatus for transferring cylindrical glass sections in glass manufacture. Address B. W. & T., 112, Hatton Garden, London, E.C.1.

The Proprietor of British Patents Nos. 190224, 190225, 193080 and 193365, all dated September 12, 1921, relating to "Improvements in and relating to Mechanism for Removing and Conveying Articles from Glass Blowing Machines," "Improvements in Take-out and Steadying Mechanism for Glass Blowing Machines," "Improvements in Machines for Blowing Glass," and "Improvements in Transfer Mechanism for Glass Blowing Machines" is desirous of entering into arrangements by way of a licence or otherwise on reasonable terms for the purpose of exploiting the above patents and ensuring their practical working in Great Britain. All inquiries to be addressed to B. Singer, Steger Building, Chicago, Illinois.

"Improvements in or relating to the Manufacture of Hollow Glass Articles." The owners of British Patent No. 112258 desire to dispose of the same or would enter into working arrangements with a firm likely to be interested. Particulars may be obtained from TECHNICAL RECORDS LIMITED, of 59-60, Lincoln's Inn Fields, London, W.C.2.

Broken Glass Wanted. Up to 500 tons. Give details and price free on rail to "Glass," Wm. Porteous & Co., Advertising Agents, Glasgow.

Wanted to Purchase. Advertiser is desirous of purchasing glass factory in or near London. Factory need not necessarily be in operation. Send full particulars to Box 312, Glass Publications, Ltd., Talbot House, Arundel Street, London, W.C.2.

In the Chancery of the County Palatine of Lancaster.

Manchester District.

In the matter of

AUTOMATIC BOTTLE MAKERS LIMITED.

For Sale by Private Treaty.

To GLASS MANUFACTURERS, ENGINEERS, WAREHOUSEMEN, etc.

Excellent Works Site, comprising 6½ acres Freehold and subject to chief. Situated in central position in Trafford Park, Manchester, with private siding connected to main system of Manchester Ship Canal Railways.

Large works buildings containing Gas Producers, Tanks, Lehrs, Machines and Air Compressors, modern three-bay Warehouse, with Automatic Conveyors and convenient loading ways, and splendidly-equipped Machine and Mould-making Shops.

Further Particulars from Receiver and Manager for Debenture Holders, James Blakey, Junior, F.C.A., 42, Spring Gardens, Manchester (City 1115), or Vaudrey Osborne & Mellor, Solicitors, 30, St. Ann Street, Manchester (Central 6078-9).

BRITISH INDUSTRIES FAIR, 1927.

It is gratifying to learn that owing to the number of applications for space in the Birmingham section of the British Industries Fair, next February, it has been decided to build extensions which will give a further letting area of approximately 30,000 sq. ft. In the London section, more than six months before the Fair opens, applications for space are already within 20,000 ft. of the total for the last Fair. In order that every possible facility may be afforded to buyers attending the Fair from abroad, the Government has decided that holders of the official invitation card may have their passports to England visaed, in cases where visas are necessary, without any charge being made.

GLASS

THE RECOGNIZED ORGAN OF THE GLASS INDUSTRY
Published on the Tenth of Each Month.

Single Copies - - - - One Shilling
Annual Subscription - - 10/6 post free

GLASS PUBLICATIONS Ltd.
TECHNICAL PUBLISHERS,
Talbot House,
Arundel Street,
Telephone: CENTRAL 5985. **Strand, London, W.C.2.**

CONTENTS.

PAGE
Editorial Notes 451
Refractories for the Glass Industry.—By W. J. Rees, B.Sc., Tech., F.I.C. (Lecturer in Refractories, University of Sheffield) 452
Slag Corrosion of Refractories 453
The Study of Glass Tank Blocks: Tank Control and Devitrification 454
Metal to Glass Joints 455
Pressed Ware 456
U. S. Government Specifications for Glass Tableware ... 456
Regenerators and Dampers 457
"Taking In" Device 459
The Melting of Yellow Glass.—By Erich Felsner ... 461
The Late Sir Ernest Oldham 463
Viscosity of Glass: The Effect of Thermal Treatment 465
Gasified Fuel 465
The Selection and Application of Oil Burners for Use in the Glass Industry 467
Trades Notes 471
The Use of Compressed Air (*Continued*).—By Robert Wilson 473
The Selection of Electric Motors (*Continued*) 477
Catalogues 479
August Trade Returns 481
Autumn Trade Problems 482
United States Patents 483
British Patents 489
Latest British Patents 492

Editorial Notes.

Although at the time these notes are being written the daily increase in the number of miners returning to work in defiance of the orders of the Miners' Federation has not reached such figures as to be called a "rush back," yet the total number returning is such as to leave little or no doubt as to the eventual finish of the dispute. This will be a general return of the men upon district agreements, in numerous instances even individual colliery agreements. The latest speeches of Mr. Cook indicate that he, together with others who depend upon their connection with the Miners' Federation to lift them from their natural sphere of obscurity and provide them with money and power they could never obtain in any other way, also realises that such is the case and is already preparing a job for himself as mischief maker, going round from district to district urging the men to break faith with the owners so that the industry and the country may be smashed.

Time spent in bemoaning the cost to the nation of the events since the beginning of May is, however, wasted. Everybody knows that it is bound to be tremendous, not only in actual cash loss now as indicated by the Trade Returns of the Country, but in the added handicap it will impose upon all British industries for a considerable time to come. Instead, every effort should be exerted in an endeavour to discover ways and means, and then bring them into being, which will make a repetition of these events impossible in the future.

The creating of a feeling of better understanding and trust between employed and employer; the education of the workers so that they can understand the elementary facts of industrial economics and thus realise that increased production per unit, whether it be man or machine, means reduced production costs, and facts of this nature, etc., etc., all are excellent and form an essential part of the scheme of industrial reorganisation that is long overdue. Unfortunately, however, they alone are not sufficient to effect the desired result, so long as it is possible for men of the type of Cook and his colleagues to debase and subordinate Trades Unions to their own political advantages.

It is somewhat humiliating to think of our "British Freedom" and at the same time know that a man who wants to work to keep himself and his family is prevented from doing so because some Trade Union official, whom incidentally the man is helping to pay, forbids him to do so.

It is no exaggeration to say that at the present time the workers of this country are not "the slaves of Capitalism," but actually are the slaves of what is termed Trades Unionism, but it is a Trades Unionism so debased and corrupt in many instances as to be nothing but a travesty of what the founders of the movement intended it to be. It has become nothing but a ladder to enable unscrupulous imposters to climb to wealth and power.

Legislative measures are required to enable the Unions to clean themselves from parasitic growths which are not only sucking the life-blood from the Unions themselves but also that of the whole Nation.

[GLASS *will deal with all matters pertaining to the industry in an impartial manner, consequently the Editor does not necessarily associate himself with the opinions expressed by his contributors.*]

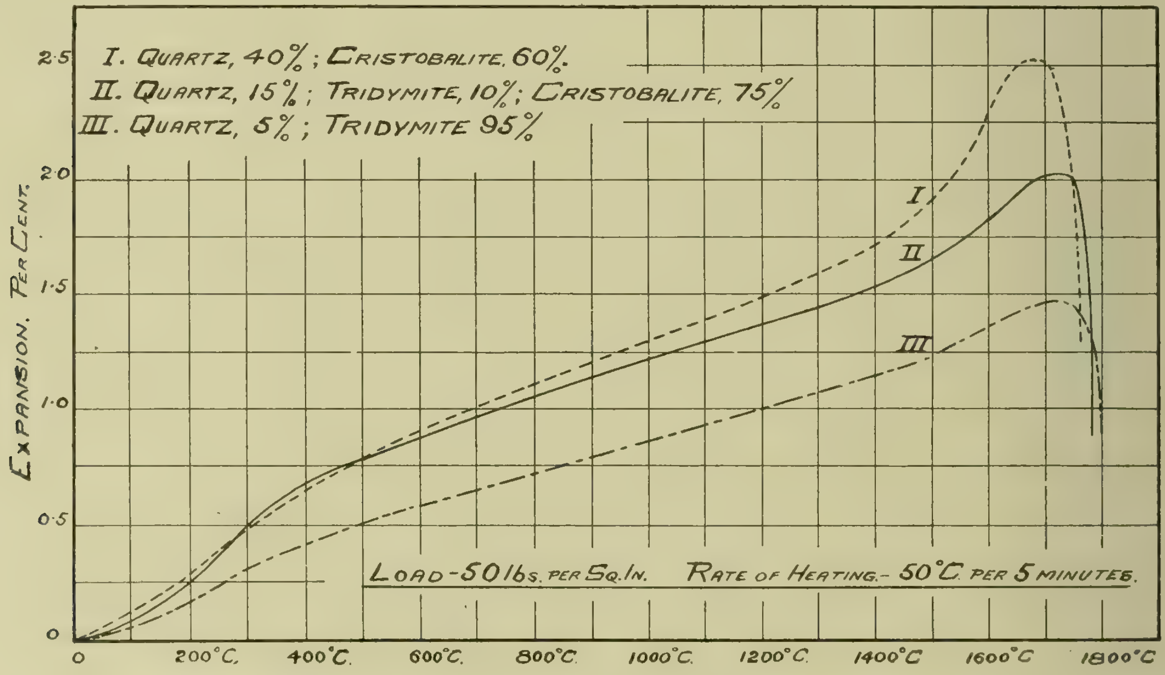
Refractories for the Glass Industry.

By W. J. Rees, B.Sc., Tech., F.I.C. (Lecturer in Refractories, University of Sheffield).

(*Continued*).

Silica Refractories.

The resistance to softening and deformation at high temperatures which is implied in the term "refractoriness" is a property which involves both time and temperature factors. In its determination an elongated tetrahedron or cone cut from the brick is cemented to the centre of a small circular plaque of highly refractory material (sillimanite + 10 per cent. plastic clay is satisfactory) and surrounded by standard cones which bend over, deform, or lose their sharpness of outline after definite heat treatment. The plaque and cones are then placed in a small furnace, the temperature of which is raised at the uniform rate of 50° C. per 5 minutes. The heating is stopped when the cone of the material under test begins to deform and its refractoriness is recorded as equivalent to that of the standard cone which has deformed to the same extent. It should be noted that this method of testing involves the use of a pyrometric scale based on the effect of a time-temperature treatment of standard cone mixtures and gives comparative results which cannot be accurately recorded in terms of temperature alone. Optical pyrometers are, however, frequently used nowadays in conjunction with test-furnaces, so that not only the corresponding cone deformation can be stated, but also the actual temperature at which the deformation occurred. Silica bricks for use in glass-melting furnaces should have a refractoriness equivalent to that of cone 31 at least, or in terms of temperature alone, a refractoriness of not less than 1690° C. The "refractoriness-under-load" which, in view of the uses to which the bricks are put and the service which is expected from them in modern high temperature furnaces, is of greater importance than the ordinary or "normal" refractoriness, will be discussed in the paragraph below dealing with the mechanical behaviour of the bricks.



Mechanical Properties.

The cold crushing-strength of silica varies considerably with the texture of the bricks. It may be as low as 800 to 1,000 lb. per square inch for a coarse open-textured brick, and as much as 4,000 to 5,000 lb. per square inch for bricks of fine texture, burned so as to obtain a network of recrystallised silica in the matrix. The transverse strength is rather more affected by variations in texture than the crushing strength, the transverse breaking load for 9″ × 4½″ × 3″ bricks placed flat, varying between 500 and 2,500 lb., and the modulus of rupture, calculated from the formula

$$R = \frac{3WL}{2bd^2}$$

between 200 and 700. It is desirable that bricks for use in glass-melting furnaces should have a cold-crushing strength of not less than 2,000 lb. per square inch and a modulus of rupture not lower than 300.

Although, as already indicated, it is important that silica bricks should have good mechanical properties at normal temperatures, their mechanical properties at working temperatures have a more direct influence on their durability. The excellent mechanical strength at high temperatures of well-made silica bricks is one of their most useful characteristics, as in this respect they are superior to even the highest qualities of fireclay bricks. Like the cold mechanical properties, the behaviour under load at high temperatures is influenced by the texture and degree of burning of the bricks. The figure on p. 452 shows the behaviour under a load of 50 lb. per square inch of the three bricks, of which the thermal and reversible expansions are shown in the figure on p. 357 (August, 1926). There is not a great difference in the temperatures at which each of these bricks loses rigidity and begins to deform under the load, but the greater expansion shown by No. I indicates the marked advantage in regard to volume stability which is obtained from the use of well-burned bricks such as No. II, and the still greater advantage which would be at hand if bricks such as No. III were commercially practicable. The increase in the velocity of quartz conversion at high temperature is well shown by the rapid increase in the rate of expansion in brick No. I above 1400° C. For use in modern glass-melting furnaces, especially in such positions as the crowns of pot and tank-furnaces and the pillars of pot-furnaces, silica bricks or shapes should be of such texture and degree of burning as to carry a load of 25 lb. per square inch at 1600° C. without deformation.

After-Expansion.

The permanent expansion which occurs when a silica brick is maintained at a high temperature is due, as has already been mentioned, to the conversion of quartz present in the brick to the forms of silica of lower specific gravity, cristobalite and tridymite. The relationship between the true specific gravity or powder density and after-expansion of silica bricks has been already discussed (pp. 279-281), and for general purposes a determination of the powder density, which can be rapidly carried out in the special flask described, is sufficiently indicative of the permanent volume change the brick is likely to undergo during its use. Specifications for silica bricks which make reference to after-expansion specify 1410° C. as the temperature at which the test-piece is to be heated, but in the author's opinion, bearing in mind the high temperatures at which modern furnaces are continuously maintained, the test-temperature should be 1500° C. A test-piece cut from a silica brick which is to be used in the construction of a high temperature furnace should not, after being slowly heated to 1500° C. and maintained at that temperature for two hours, show when cold a greater expansion than 1.0 per cent. linear. The size of the test-piece should be approximately three inches in length and 1 to 2 inches in width and depth.

Size and Shape.

It is very desirable that the surfaces of the bricks should be true so that they may be used with the minimum quantity of cement. In building the crowns of furnaces the practice of setting the silica bricks dry and applying the cement as a grouting is extending, and necessitates the use of bricks with plane surfaces and of uniform dimensions. Modern methods of silica brick manufacture are sufficiently exact to warrant specifying a maximum variation from any specified dimension of silica bricks or blocks of plus or minus 2 per cent.

Storage.

It is desirable to direct attention to the necessity for storing silica bricks under proper conditions. The author has shown by a series of experiments* that even hard-fired bricks of normal chemical composition and close texture show a decided deterioration in mechanical strength and an increase in spalling tendency after exposure, unprotected from rain, wind, etc. This change in properties appears to be due to a degradation of the bond by hydration and solution in water as well as to the physical effect of repeated wetting and drying. Silica refractories should always be stored in dry, ventilated sheds.

(*To be continued.*) 3/15

SLAG CORROSION OF REFRACTORIES.

The report of the Refractory Materials Joint Committee submitted at the London meeting of the Institute of Gas Engineers, contains a paper on "The Testing of Refractory Material for Resistance to Slag Corrosion and Erosion," by Mr. A. Dale, B.Sc. The author points out that a very appreciable item in production costs in many industries, including the glass industry, utilising high temperatures, is due to the deleterious inter-action of refractories and molten slags. In the regenerators, foreign matter, carried forward by the gases, impinges on the chequer work, resulting in continued surface action. The efficiency and life of the regenerators is adversely affected, as either the face of the chequers is continually dissolved in a downward trickle of a corrosive slag, or an adherent layer gradually develops. In gas producers there is also frequently excessive attack of the brickwork by the ash and clinkers.

Numerous other instances were mentioned by the author as showing the diversified ways in which slag-brick inter-actions materially increase production costs. Generally speaking, this may be lessened by (1) structural modifications, elaborations and temperature control; (2) by control of the chemical, minerological, and physical constitution and nature of the refractory materials. Those falling under class 1 were outside the scope of the paper, but the author mentioned that advantages might often be obtained from the readjustment of internal furnace contours, elimination of fuel and other dust from the heating gases, the application of special air or water cooling to reduce the hot face temperature of refractory linings, the conservative use of thermal insulation, the control and limitation of working temperatures below the prescribed maxima, and the control of slag composition. The author then proceeded to recount what had been already achieved in the classification 2, and suggested further work which the British Refractories Research Association expect to be in a position to develop in the near future.

---

* Trans. Ceram. Soc., 1925, 62, and 1926, 150.

The Study of Glass Tank Blocks.

Tank Control and Devitrification.

Some time ago it was announced that the U.S. Bureau of Standards proposed carrying an investigation on the factors controlling the life of tank blocks. Mr. G. K. Burgess, the director of the Bureau, has just issued his report, and in it are given the results of the investigation just referred to, which are as follows :—

When tanks first replaced pots for the melting of glass, an average life of from 20 to 24 months was not unusual. Since this time the speed of production has advanced so that considerably more glass is melted, not only for the same melting area, but also at higher temperatures. This has resulted in the lowering of the average life of tanks to from 10 to 12 months, and made it desirable to undertake a study of the factors controlling the life of tank blocks. This has involved the study of not only the physical and chemical characteristics of various blocks, but also a chemical and petrographic study of the compounds formed by the reaction of the glass and the clay block. Since the glass is practically a solution of flint, soda ash, and limestone (the flint being acid in reaction while the soda ash and limestone are alkaline), there has been a difference of opinion as to whether or not the best type block should be relatively low or high in silica content. The blocks used in the investigation were representative of all of the commercial brands now on the market, and several were also prepared in the laboratory, under controlled conditions, varying not only the composition, but also the pore structure so as to produce certain extremes. The blocks were tested in a small glass tank constructed for the purpose. This tank was sufficiently large to use the commercial block, and 400 pounds of glass were melted per day for 30 days in each tank. After this test the blocks were examined as to depth of penetration of glass, amount of erosion, reaction products on the block surface, etc. The commercial block ranged in softening point from that of cone 27 to that of cone 32. The silica content varied from 9 (special corundum block) to 73 per cent., and the alumina from 23 to 89 per cent. The total absorption ranged from 8 to 15 per cent., of of which from 50 to 75 per cent. were so called large pores. Petrographic examination showed that the internal structure of the clay block (slightly back of the exposed face), is practically unaltered after the test. Gradually approaching the face exposed to the glass, there is a slight vitrification of the block, with an increase of interstitial glass and in the size and quantity of mullite crystals. Approaching to within about one-quarter inch of the face the interstitial glass is augmented by intrusions of glass from the tank into the larger pores. The tank glass, since it contains the fluxing agents soda, lime, and magnesia, dissolves and carries away the interstitial glass, leaving behind a high concentration of mullite which goes to make up very largely that intermarginal white layer seen on practially all blocks when they are removed from a dismantled tank. The microscope further shows that, at the outer face of this white layer where there is freer access to the main body of the glass, the mullite has apparently gone into solution and that corumdum has crystallised out. The data obtained to date appear to justify the following general conclusions :—(1) Corundum and mullite, under the physical conditions existing at the contact of tank block and molten glass and with the concentration obtaining, resist solution better than other possible solid glasses and, therefore, refractories made of these materials should show the greatest resistance to glass attack. (2) The physical structure of the clay block is the predominating factor controlling its life in service irrespective of chemical composition. The block should be homogeneous, the pores should be small and if possible, closed or non-interconnecting, and this structure should be obtained with a minimum of interstitial glass. (3) The solution of submerged portions of the block is due primarily to accelerated attack of the glass on the upper surfaces of pores, cracks, and laminations rather than to erosion brought about by movements in the main body of the glass. (4) The use of very high temperatures (1,450° C. and higher) can be expected to materially shorten the life of such block, due to the decreased viscosity of the glass and the increased solubility of the tank block constituents.

TANK CONTROL AND DEVITRIFICATION.

The Report, also, deals with the work done in the prevention of devitrification and mentions that the prevention of devitrification (crystallization) in their products is of major importance to glass manufacturers. No systematic method of changing batch compositions or furnace temperatures to prevent devitrification can be formulated, however, until a knowledge is obtained of the stability regions and temperatures of crystallizations in the systems to which the glasses belong. In the absence of exact data of this nature for the system soda-lime-silica to which most of the window, plate and bottle glasses belong, an investigation was undertaken to obtain approximate values indirectly, using the petrographic microscope. By this method the copositions of the crystalline materials produced in soda-lime glasses were determined and were found to be wollastonite (CaO. SiO_2) and Na_2O, 3CaO. 6 SiO_2 in window and plate glasses and cristobalite (SiO_2) in bottle glass. The approximate chemical compositions of the glasses were also determined and, with these data, the boundary lines between the regions where the crystalline materials occurred as primary phases were drawn. With the results of this study and knowing the composition of the devitrification crystals, the glass manufacturers may determine in what direction the batch composition is to be changed in order to avoid further trouble.

METAL TO GLASS JOINTS.

In a paper read before the Royal Society of Arts* on the "Production and Measurement of High Vacua," G. W. C. Kaye, O.B.E., M.A., D.Sc., Superintendent of the Physics Department at the National Physical Laboratory, dealt with the question of making joints between glass and metals. As is well known, the prime essential is that the co-efficients of expansion of the metal and the glass should be in close agreement over the temperature range employed, or, that by suitable design any stress due to unequal contraction shall be so accommodated that in the end it does not exceed the mechanical strength it is possible to give the metal to glass union.

Up to about 12 years ago platinum was the only metal readily available which had an expansion co-efficient approximating to that of soda or lead glass (about 9×10^{-6} per ° C), and consequently platinum was used universally as, for example, in the sealing-in wires of electric lamps. Owing, however, to its great increase in price it was necessary to find suitable substitutes for commercial purposes.

In spite of the difference between their expansion co-efficients, it had been known for a long time that it was possible to occasionally succeed in sealing a fine copper wire directly into glass, the chance of success being increased if the wire was flattened. The best results are obtained by using a feather-edged tape or ribbon, inside a flat "pinch" seal, at the same time keeping the glass round the tape sufficiently thin to afford the necessary accommodation. Copper tubes can be joined to glass tubes in the same way. The end of the copper tube should be turned down to a feather-edge in order to give a good fitting taper joint with the glass tube, and have an overlap of only a few millimetres. The glass may be either inside or outside the copper tube.

In order to obtain successful results the following procedure is advised. The copper should be heated in an oxidizing blow-pipe flame until it assumes a coating of black oxide. It is then dipped into a saturated solution of borax and re-heated in the flame. This process is repeated until a thin film of the salt spreads over the metal and combines with the oxide to give a ruby-red copper borate. Under these conditions the glass will readily adhere to the copper when the two are heated in the blow-pipe flame. The joint should not be more than a few millimetres wide and should show everywhere the brilliant red colour of copper borate.

At the present time, however, copper has been largely replaced by alloys with expansion co-efficients approximating to that of glass, so that the design of the joint becomes less important, as there is a decreased demand on the mechanical strength.

A nickel-iron alloy, containing 50 per cent. or a little less of nickel, has a co-efficient of expansion closely approximating to that of soda or lead glass, and is now largely used for metal to glass joints. The alloy is first coated with a thin layer (about 0.001 inch) of copper, and the joint made in the manner just described. Tubes can also be joined with the glass, either inside or outside the alloy, but for large diameters it is preferable to have the glass outside. For the sealing-in wires of electric lamps, small radio valves, etc., the electrical resistance of this alloy is too high, so a composite wire is made of a 40 per cent. nickel alloy, coated with copper, the copper section being about 20 per cent. that of the whole.

Chrome-iron alloys were developed for sealing in to glass by Phillips Lamps, Ltd. The alloy used is approximately 75 per cent. iron and 25 per cent. chromium, and its expansion co-efficient about 10×10^{-6} per ° C., i.e. very close to that of glass. Stainless steel (85 per cent. iron, 15 per cent. chromium) has a somewhat greater expansibility.

The 25 per cent. chromium alloy is not rustless, but is wetted by molten glass and can therefore be joined directly to glass without the necessity for copper plating.

To make a joint, the alloy is first slightly oxidized by heating in an oxidizing flame (an oxy-coal gas flame will do), a "thread" of glass is melted onto the edge of the alloy at the proposed line of the joint, and the joint is then completed by fusing this to the glass component. The overlap should not be more than 1 to 2 millimetres wide, and the edge of the alloy is usually tapered off a little. This alloy can be heated without injury to 1,000° C. and is a little harder than mild steel.

Unless the expansion co-efficient of the alloy exceeds slightly that of the glass (within the limits of 0.5×10^{-6} to 0.9×10^{-6}) it will be found that the joint is apt to fail eventually, whether it has the glass internal or external.

The Research Laboratories of the General Electric Company at Wembley have developed methods of jointing glass to fused silica. The procedure adopted being to join the soft lead glass to a hard glass through several special glasses in diminishing order of expansion co-efficients, the hard glass is then joined to "Pyrex," and if this has to be joined to silica the free end of the "Pyrex" is heated in the blow-pipe flame until it has lost sufficient boric oxide to enable it to weld to the silica. The several intermediate glasses, although they differ in melting points, composition and co-efficients of expansion, must be so completely fused with one another that each one largely loses its identity, so that the properties of the graded joint vary gradually and continuously from one end to the other.

◆

It is now fifty years since the American Chemical Society was founded in 1876, and to commemorate the fact, the September issue of *Industrial and Engineering Chemistry* contains articles by leading men, each of whom deals with the progress made in some particular industry during the last half century.

Glass is especially favoured, as there is an article, "Fifty Years of Glass Making," by Alexander Silverman, of the University of Pittsburg, and also an article, "A Half Century of Progress in the Glass Industry," by George W. Morey, of the Geophysical Laboratory, Washington, D.C.

In both papers, the development of the industry from a technical point of view is briefly outlined, as showing the results obtainable from research and scientific investigation.

---

*Journal Roy. Soc. Arts, No. 3853.

PRESSED WARE.

Some time ago we mentioned that as far as we were aware no English factory was operating a completely automatic press in conjunction with a " feeder," for the production of table ware. It is safe to say, we think, that this still holds true, and we therefore feel that the following figures will prove of interest as showing the productions that *are being obtained* in American factories.

The figures were contributed by a correspondent to the *American Flint*, the organ of the American Flint Glass Workers' Union.

Article.	Production per minute.
Light table tumblers	28
Heavy table tumblers	23
3-pint water pitcher	10
2-handled sugar	14
Creams, pressed handle	15
Sherbets—flat foot	19
Ash trays	20
4-inch Colonial nappy	26
4-inch Plain or star bottom	32
4-inch mixing bowl	24
6-inch mixing bowl	18
9-inch mixing bowl	10
Sugar covers	25
5-inch handled nappy	18
5-inch footed jelly	15
Butter boxes	14
Butter covers	19
5-inch high-footed compot	15
Sundae	22
6-inch plates	15
6-inch vase	16
2-handled pickles	25
Orange reamer	13
Flat foot wines	18
Jugs, 57 ozs. capacity	9
Jugs, 34 ozs. capacity	11
Jugs, 21 ozs. capacity	13
Large creams	15
Small creams	19
5-inch nappy	22

U.S. GOVERNMENT SPECIFICATIONS FOR GLASS TABLEWARE.

The U.S. Government master specification No. 121, for Glass Tableware, which was adopted on February 20th, 1924, was the subject of an article appearing in *Technical News Bulletin* for September, issued by the Bureau of Standards. The original specification has been revised in two essential respects, the first being a change from 11 to 10 fluid ounces for the capacity of the specified tumbler, and the second the introduction of permissible variations from specified requirements.

The specification describes the following glass articles in the sizes indicated :—

Article.	Capacity. Fluid Ozs.	Weight. Ozs.	Diameter. Inches.	Height. Inches.
Tumbler	10.0	12.0	*$2\frac{7}{8}$	$4\frac{1}{4}$
Vinegar bottle	14.5	18.5	†$3\frac{5}{8}$	$8\frac{3}{4}$
Syrup pitcher	20.0	32.0	†4	$6\frac{3}{8}$
Salt shaker	3.0	—	$2\frac{3}{4}$	4
Pepper shaker	3.0	—	$2\frac{3}{4}$	4

* At top. † At bottom.

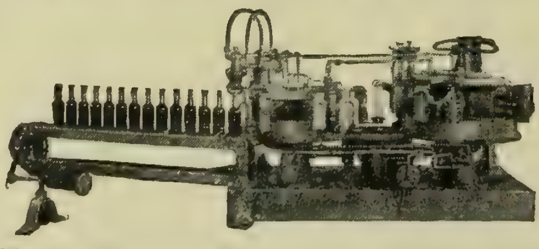
The tolerances which are permitted in weights and measurements are as follows :—

Dimensions	3.0 per cent.
Capacity	4.0 ,,
Weight	6.0 ,,

Detail drawings accompany the specifications as indications of the general shape of each article, which may be either hand or machine made from either lead or lime glass. The glass as determined by visual inspection must be of good colour and free from heavy cords, stones and fine cracks ; a few small scattered bubbles are permissible, but in no case are these or other defects allowed if they spoil the appearance of the ware.

Two tests as to serviceability are given. The first consisting in boiling the article in distilled water for six hours, after which it should show no evidence of corrosion, scumming, chipping or cracking. The second is a shock test and consists of immersing the article in tap water at room temperature for ten minutes and then quickly plunging it into boiling water. The ware should withstand this operation being repeated five times without showing any signs of cracking.

AUTOMATIC



May be Worked on Floor Level—No Pit Needed

NARROW NECK AND WIDE MOUTH
BOTTLE BLOWING MACHINE
No Transfer Boy. No Take-Out Boy.
STRICTLY AUTOMATIC
When Operated with Mechanical Feeding Device.
Can be Worked by Hand Gatherers. Speed 10 to
32 Bottles per minute, ranging in size from ¼ oz.
to Gallon
LYNCH GLASS MACHINERY COMPANY,
ANDERSON, INDIANA, U.S.A.
Cable Address—"LYNCHNOBOY" ANDERSON
Codes—A.B.C. 5th EDITION, BENTLEY'S, WESTERN UNION

REGENERATORS AND DAMPERS.

In spite of the fact that the fuel efficiency of a furnace depends to a very large extent on the efficiency and operation of the regenerators it is remarkable how infrequently pyrometers are provided for even indicating, never mind recording, the temperatures existing in the regenerators.

Of course, it is useless to install this equipment unless means are also provided whereby the operator in charge of the furnace is able to take full advantage of an intelligent interpretation of what the temperature measuring equipment shows, otherwise he is in the position of the captain of a ship with an excellent compass but no rudder.

Although a regenerative furnace may be built with the utmost care, and all precautions taken to see that both sides of the furnace are exactly alike and, so to speak, balanced, yet when it is put into operation it will usually be found that one side works differently to the other. This may be due to atmospheric conditions, i.e. the prevailing wind is on one side, etc., etc., but whatever the reason may be, the results are the same, and it will be found that one set of regenerators work hotter than the other.

Again, it will usually be found that after the hot gases have passed through the furnace they divide themselves and pass into the gas and air regenerators on their way to the chimney without their being any control as to the proportion in which such division is made.

This is accounted for by the fact that usually only one damper is provided between the furnace and the chimney with the result that should by any mischance the air chequer work or flues become at all blocked or obstructed, the hot gases automatically accommodate themselves to the new conditions, and on leaving the furnace a greater proportion will pass through the gas chamber than is requisite, consequently the air chamber is starved and on the next reversal the temperature of the air passing to the tank will be lower than it should be.

Of course, if the obstruction is in the gas chequers or flues, more waste gases will pass through the air chamber.

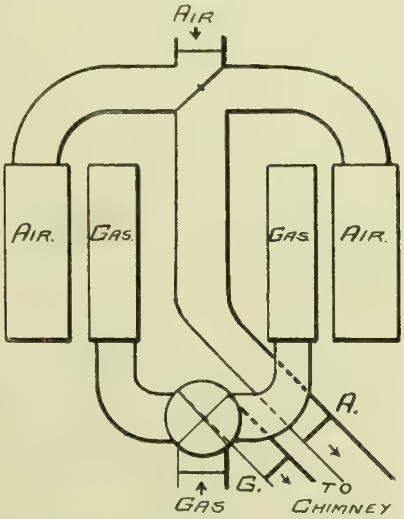
It should not be forgotten, however, that these effects are cumulative, and the final result is a complete unbalancing of the furnace operation.

The majority of these troubles can be overcome by the provision of two extra dampers, i.e. one in the flue from the gas chambers to the chimney and the other in the air flue to the chimney, as shown in the diagram. If these are provided the furnace man has complete control over the distribution of the waste gases between the two chambers.

Furnaces, like most mechanisms, and all people, have their peculiarities which require careful watching and attention if the best results are to be obtained. In this connection may be mentioned the question of "reversing" at constant intervals of time. The exact periods differ in different works and countries. In some, reversals are made every half hour, this being the usual interval, in others it is every twenty minutes, whilst yet others have adopted one hour periods as their standard.

From the point of view of the temperatures of the gas and air entering the furnace through the ports, the shorter the intervals between reversals, theoretically, the better the results should be, due to the fact that the gas and air temperatures would have higher average values as there would not be the big differences (often as much as as 300-350° C.) between those immediately after one reversal and those immediately before the next. This would, of course, result in more regular furnace operation and also a slightly higher furnace temperature.

In practice, however, this does not work out quite correctly, as at each reversal there is a period during which no combustible gases enter the furnace; in addition, also, there is usually a loss of gas which escapes up the stack, consequently it will be found that twenty minutes is the shortest interval at which reversals can be made economically.



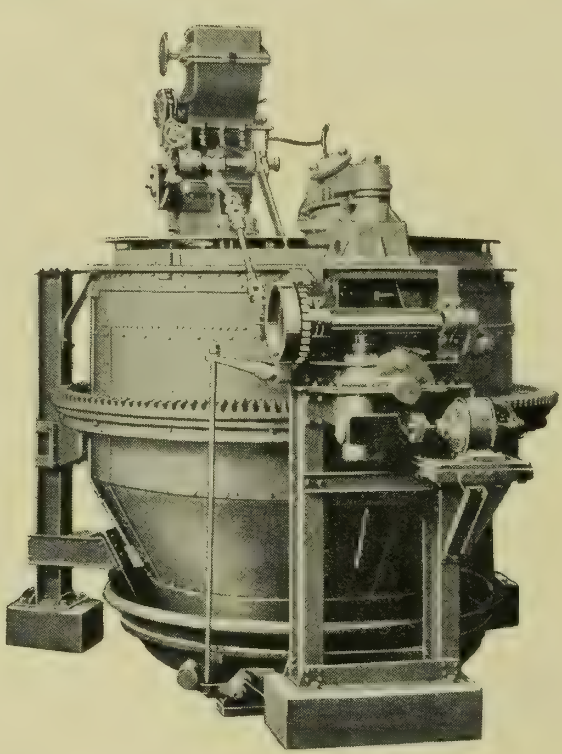
A = **Damper controlling Air Regenerators.**
G = **Damper controlling Gas Regenerators.**

Once the interval has been decided it is advisable that means be installed (such as a reversion recorder) to see that the time is being adhered to, as, under normal working conditions, satisfactory furnace operation can only be obtained in this way. Circumstances do arise, however, when a departure from this fixed time-table is not only allowable but advisable. It may be found that one side of the regenerative system is colder than under normal conditions. If only one of the chambers, gas or air as the case may be, is affected, the matter can usually be rectified by adjusting the division of the waste gases between them by means of the two dampers previously mentioned. If, however, both chambers are below normal, then the time during which the waste gases pass to the chimney through the other side of the system should be cut down a little by reversing slightly earlier for once, and thus allowing the cold set a little longer time for heating up. Care must be exercised, however, to see that too great a difference is not made, as otherwise the conditions may be completely reversed and things go from bad to worse. Nevertheless, with a

WELLMAN GAS MACHINES

INCREASE OUTPUT

BY INSTALLING WELLMAN TYPE "L" GAS PRODUCERS.



Automatic from coal feed to ash delivery.

Oscillating Poker ensures constant rich gas at all outputs.

Intermittent ash pan motion prevents clinker bridging.

Lowest labour and running cost of any producer.

The result of twenty years' continuous experience in the manufacture and running of over 1,300 Gas Producers.

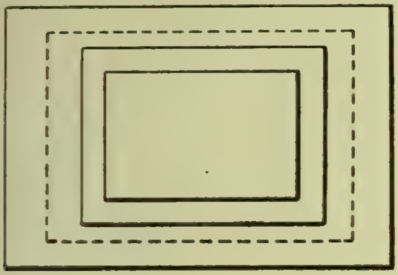
Every Glassworks Manager and Engineer should send for our handbook on Gas Making.

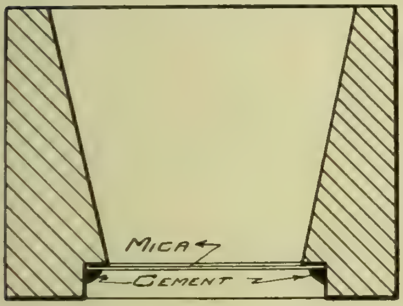
THE WELLMAN SMITH OWEN ENG. CORP., LTD.

VICTORIA STATION HOUSE, VICTORIA STREET, LONDON, S.W.1.
WORKS :: :: DARLASTON, SOUTH STAFFS.

Telephones: VICTORIA 7752-3-4. *Telegrams:* "PRINCIPIUM, SOWEST, LONDON."

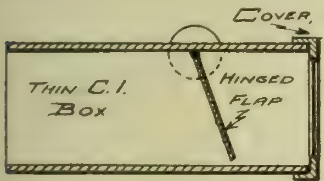
little care and judgment a good furnace man can, provided he has the necessary facilities, maintain a furnace in good equilibrium in this way.

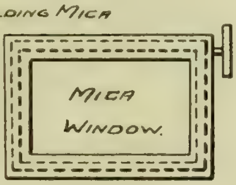




Whilst on the subject of regenerators, perhaps the writer may be excused for mentioning a point which is evident in many works.

When building up the end walls of the chambers it is usual to leave a "stopper" projecting at one or two places and levels in order that by withdrawing them the interior of the chambers may be seen. Of course, these stoppers are a loose fit and are supposed to be "clayed" round in order to prevent the entrance of cold air, but how often are they found clayed up? and should they happen to be made air-tight it usually means burnt fingers to get them out. The sketches below show two devices used to avoid all troubles in this connection. The first is simply a special block, the dimensions of which are such as will conform with the bricks used. It is made two courses thick and nine inches long. The front is a sheet of mica, which will stand up to the temperature likely to be met with. One of these blocks is built in wherever a loose stopper would have been left, and due to the cutting away on the inside will be found to give a much better view of the chequer work than was possible with the old way, whilst troubles due to cold air getting in, etc., are completely avoided.



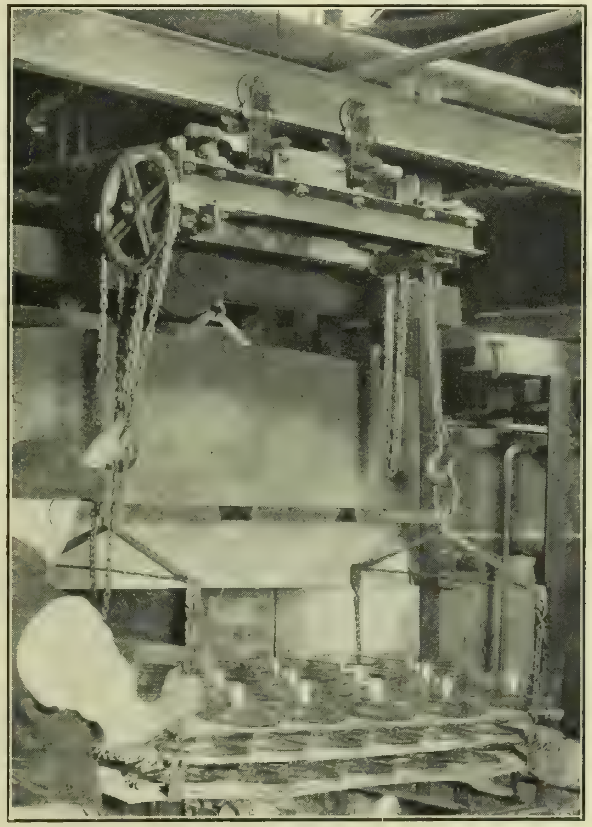


The second device is simply an elaboration of the first, and consists of a small cast iron box, fitted with small flap valve to cut off the heat from the mica front, which prevents the entrance of cold air.

"TAKING IN" DEVICE.

"Taking in" is generally considered by works managers to be one of their bug-bears.

Messrs. James A. Jobling & Co., Ltd., Sunderland, who purchased the British and Colonial patent rights for "Pyrex" glass and are producing it in large quantities at their Sunderland works, have given us permission to publish the illustration which shows the method employed by them for taking the ware from the machines to the lehrs.



The method of transportation employed consists of an overhead runway, on which are mounted travelling pulley blocks of quite unusual construction, the object being to provide a perfectly vertical lift. This is accomplished by means of two hooks which lift simultaneously, and are so inter-connected by suitable gearing, and provided with an automatic brake, that any slip or jar is quite impossible.

Each lifting hook is provided with a special loop sling, obivating the necessity for shackles, etc., on the trays themselves, whilst the use of the runway has resulted in materially shortening the time during which the lehr door is open, an advantage which will be obvious.

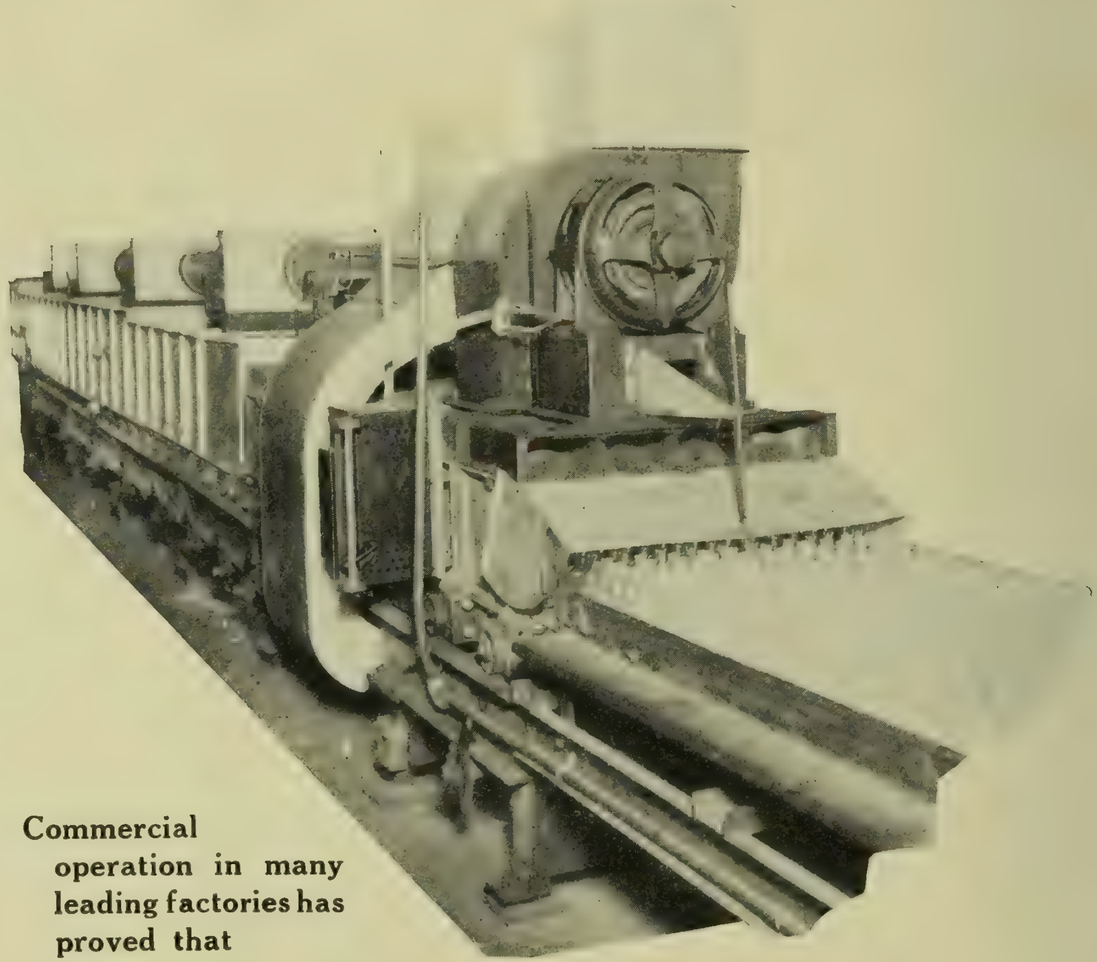
We are indebted to Messrs. Herbert Morris, Ltd., who designed the special equipment for the use of the photograph.

Another Scientific Development

THE HARTFORD LEHR

IS CREATING

A NEW STANDARD OF ANNEALING



Commercial operation in many leading factories has proved that

THE HARTFORD LEHR

1. Gives **" GRADE A " ANNEALING AT ALL TIMES.**
2. Saves FUEL (as high as 85% saving has been shown).
3. „ WARE (No " Lehr Loss ").
4. „ LABOUR.
5. „ SPACE.
6. „ UPKEEP EXPENSE.

The British Hartford-Fairmont Syndicate Ltd.

142-143 Audrey House, Ely Place, London, E.C.1.

"HARTFORD" AUTOMATIC FEEDERS - FORMING MACHINES - LEHRS

The Melting of Yellow Glass.*

By ERICH FELSNER.

Of all varieties of coloured glass, yellow glass is the most difficult to make. It requires much attention and a special method of melting in order to produce a glass entirely free from blisters. Although there are a large number of colouring agents available for the manufacture of yellow glass, it is not easy to obtain a product of a definite colour.

The following gives a number of tested colouring agents for the different grades of colour. The quantities are calculated on a basis of 100 lbs. of sand. Any good glass batch can be used to give a basic glass in combination with these colouring agents.

ORDINARY YELLOW :			
Soda ash batch	Graphite	1¾	lbs.
	Charcoal	2¾	,,
	Wheat flour	5½	,,
	Coal	1	,,
ANTIQUE YELLOW :			
Soda ash batch	Manganese	5	lbs.
	Iron oxide magnetite	2	,,
	Sulphur	0.3	,,
AMBER YELLOW :			
Potash batch	Sawdust	4	lbs.
Potash—Soda ash batch	Cadmium sulphide	6	,,
	Sodium sulphide	1	,,
	Sodium uranate	1.2	,,
	Potassium bichromate	0.1	,,
	Antimony	0.15	,,
Soda ash batch	Sodium uranate	1.3	,,
	Antimony	0.25	,,
GOLDEN YELLOW :			
Soda ash batch	Manganese	3	lbs.
	Iron oxide	1.5	,,
	Tartaric acid	2	,,
Potash—Soda ash batch	Charcoal	3	,,
	Tartaric acid	1.5	,,
	Borax	1.5	,,
Bottle Glass—Salt cake batch	Graphite	2	lbs.
	Manganese	5	,,
or :	Manganese	6	,,
	Coal	1.2	,,
	Graphite	1.2	,,
CANARY YELLOW :			
Potash—Lead oxide batch	Cadmium sulphide	2.5	lbs.
	Sodium sulphide	0.75	,,
	Tartaric acid	1	,,
	Borax	0.75	,,
or :	Sodium sulphide	1	,,
	Cadmium sulphide	3	,,
	Flowers of sulphur	0.2	,,
Potash—Soda ash batch	Flowers of sulphur	0.8	,,
	Cadmium sulphide	0.25	,,
or :	Flowers of sulphur	1.25	,,
or :	Sodium uranate	1.2	,,
	Manganese	0.45	,,
	Antimony	0.12	,,
	Potassium bichromate	0.8	,,
	Cadmium sulphide	1.25	,,
	Uranium oxide	0.5	,,
	Flowers of sulphur	0.35	,,
Potash batch	Sodium uranate	0.375	,,
Opaque glass batch	Uranium oxide	1.2	,,
	Antimony	0.18	,,
IVORY YELLOW :			
Opaque glass batch	Manganese	4	lbs.
	Iron oxide	1	,,
YELLOW OPAL GLASS :			
Potash—Bone ash batch	Silver	0.10	lbs.
Potash—Soda ash-bone ash	Silver	0.11	,,
	Sodium uranate	1	,,
	Potassium chromate	0.15	,,
	Cadmium sulphide	5	,,
YELLOW-BROWN :			
Soda ash batch	Manganese	3	lbs.
	Coal	3.5	,,
or :	Coal	2	,,
	Graphite	1¼	,,
BROWN :			
Soda and batch	Manganese	14	lbs.
	Graphite	5	,,
	Wheat flour	4	,,
	Birchwood charcoal	1¾	,,
or :	Manganese	5	,,
	Iron Oxide	2	,,
	Wheat flour	2	,,

Besides the batches given above, there exist a number of other colouring agents with which yellow glass can be made in different tones. It is easier to obtain the right colour than to melt the glass properly.

The melting process of yellow glasses differs from that of other varieties of glass. It must be conducted in a special way if good results are to be obtained. While usually substances are added to aid the fining and to cause the formation of gas, this is not done in the manufacture of yellow glass. Yellow glass foams considerably, according to the colouring matter employed, and its quantity. A thick layer of foam is formed above the molten glass, which may go over the edge of the pot. This often causes large losses of glass. The batch melts very slowly, since the heat cannot penetrate the heavy layer of foam.

This strong foaming may be prevented by the addition of fluorspar or common salt. These act well, but can only be used in limited amounts, to prevent changing the quality of the glass, and to avoid making the batch too expensive.

Usually yellow glass is made in a pot, at a low temperature. It does not foam so much under these conditions, but never becomes completely fined. Such glass may foam during changes in temperature and during working. This evil can only be avoided by a thorough melting of the glass.

Glasses coloured with graphite foam the most. But even these can be made without addition of fluorspar or salt and a non-foaming glass is obtained if the melting is done as follows :

First the available cullet of the same composition as the glass to be melted is put in the pot. Even if the pot is only half full, no batch is added. The cullet is melted completely. If no more foam appears, the batch is put into the pot. Experiments to add both cullet and batch have not given satisfactory results. The batch will remain together in lumps which stick to the bottom. This makes the melting time much too long. If new batch is added to the half-melted material, while it is foaming, much gas remains occluded in the glass which will escape during the fining process. This

---

* Kevamishe Rundschav. Vol. 34, No. 13, p. 211.

DIAMOND SAND

FROM THE

UNITED HOHENBOCKA GLASS SAND MINES

OF

H. WEICHELT & CO.

IS THE PUREST IN THE WORLD

SILICA	99.931%	MAGNESIA	0.001%
FERRIC OXIDE	0.009%	TITANIC ACID	0.006%
ALUMINA	0.037%	ALKALIS	0.010%
LIME	0.006%		

CONSISTENTLY UNIFORM.
UNVARYING GRAIN SIZE.

Makes the most Brilliant Glass and *saves* Fuel, Decolouriser, Trouble, Time and Money.

No Middlemen! We deal direct from Mines to you.

We satisfy customers all over the World.

May we quote you?

18 72
WEYSS IST DER SAND

H. WEICHELT & CO.,
8, ANTON-GRAFFSTR., DRESDEN, GERMANY.

causes strong foaming, which may cause the contents of the pot to run over the edge of the pot. In such a case it is necessary to keep the pot cool in order to prevent loss. However, only glass that is incompletely fined is obtained, and it may foam at every small change in temperature.

The additions of batch should be made only in small amounts in order to obtain a thoroughly melted glass. If a strongly foaming glass is being made, the best quantity to add is two shovelfuls at the time. Observations regarding the melting time of such glass gave the following results :

1 shovelful in 10 minutes
2 shovelfuls in 25 minutes
3 shovelfuls in 45 minutes
4 shovelfuls in 80 minutes
5 shovelfuls in 130 minutes
6 shovelfuls in 180 minutes
7 shovelfuls in 235 minutes
8 shovelfuls in 300 minutes

This shows that with increasing quantities the melting time per shovelful increases considerably. It is tedious to fill up a pot gradually, but this trouble should be disregarded. It is the only way to obtain a high quality, well melted glass, that does not foam during changes of temperature. The last addition of batch should take place 45 to 60 minutes before the end of the melting period. This is easily accomplished and is necessary to obtain an even colour.

If small objects are being made, so that the pot contains already much glass at the beginning of the melt, it is best to add no cullet, but to wait till the pot is entirely empty.

If the melting is done as described, it is quite possible to fill up the pot to the brim and if done in this fashion there never occurs a case of foaming. It might be feared that the glass will not become homogeneous and will contain waves and lines. This, however, is never the case, since on account of the fact that the glass is foaming considerably, the glass mass is continually moving, so that the different parts are being mixed thoroughly, with every new addition of batch.

◆

According to an announcement by the U.S. Department of Commerce, at a conference in New York, between the manufacturers of milk bottles, distributors, and experts of the Division of Simplified Practice, it was decided to adopt four standard sizes of milk bottles instead of the nine now in use. It was agreed, says the *United States Daily*, that there should be two quart sizes, one 9½ inches high, and the other 9¼ inches ; one pint size 7¼ inches high ; and one half-pint size 5¾ inches

◆

A material sold under the trade name of " Vitrox " is claimed to improve materially the mechanical strength of almost all clays to which it is added, this being especially noticeable after firing, whilst the tendency to warp in firing is greatly reduced.

The action of this material is stated to be analogous to alloying steel with some element, such as chromium, tungsten, etc.

THE LATE SIR ERNEST OLDHAM.

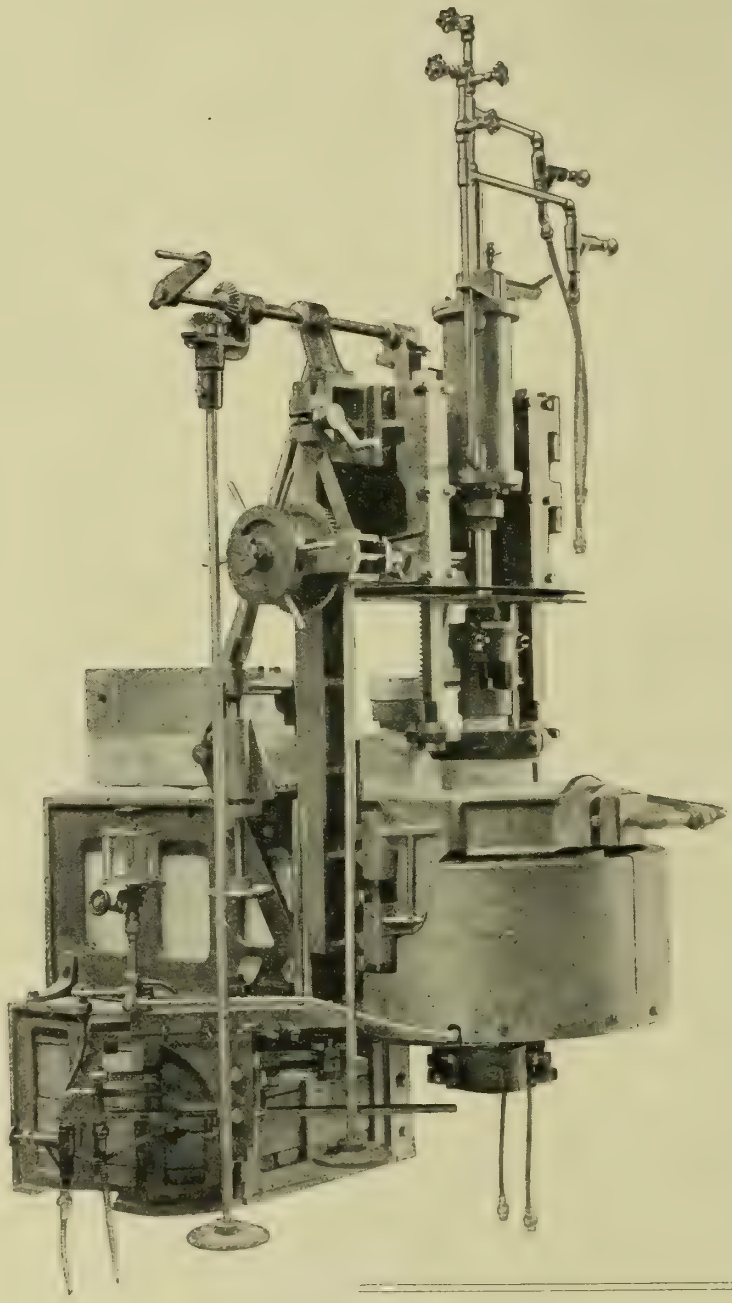
It is with the most sincere regret that we announce the death of Sir Ernest Fitzjohn Oldham, at Chievely, Berkshire, on Wednesday, September 22nd. A solicitor by profession, Sir Ernest was the senior partner of Messrs. Vizard, Oldham, Crowder & Cash, Lincoln's Inn Fields, London, and for several years had been a member of the Council of the Law Society.

During the War his age debarred him from joining a combatant unit, but he served in the air craft defences of London and was legal adviser to the Foreign Trade Department. He was also very closely and actively associated with the foundation of the Federation of British Industries, of which he became Deputy Chairman and Vice-President, and in 1921 received the honour of knighthood as a recognition of his many and varied public services.

He had numerous interests in the glass industry, as in addition to being Chairman of the United Glass Bottle Manufacturers, Ltd., he was a director of the Libbey Owens Co., Belgium, etc. He avoided publicity, however, and only those who have had the privilege of working with, or coming into close personal contact with him can as yet appreciate to the full what his loss will mean. They will miss the advice of a keen though kind, straightforward, capable leader, one of whose great interests in life was the welfare of the British glass industry.

On Monday afternoon, September 28th, a memorial service was held at St. Martin's-in-the-Fields, Trafalgar Square. This was attended by a large number of Sir Ernest's personal and business friends.

The **"RANKIN"** Automatic Glass Feeder.



RESULTS JUSTIFY CLAIMS.

Claims without justification are futile.

The need for automatic production is admitted by every glass manufacturer. The question is—what mechanism can be installed with the assurance of the best results?

The " RANKIN " record is unrivalled in the Glass Feeder world. Its history is unique. In no instance has a " RANKIN " installation once installed been superseded. On the contrary, wherever it has been adopted, further installations have followed.

The latest proof of this claim is a repeat order for **TWELVE FEEDERS** from a Glass Manufacturing Company, who originally put in one Feeder for comparison with other similar devices. This we believe to be

THE LARGEST INDIVIDUAL ORDER EVER PLACED FOR AUTOMATIC FEEDERS

and represents a great triumph for an All-British Built Feeder.

The mechanism, material and finish are of the highest possible quality. The " RANKIN " Feeder is built for service and will outlast all others.

Demonstrations of the RANKIN AUTOMATIC GLASS FEEDER will be arranged by appointment.

For Illustrations, Descriptive details and terms apply to :

THE RANKIN AUTOMATIC GLASS FEEDER CO.,

1, CHARTERHOUSE STREET, LONDON, E.C.1.

Telegrams : Natiglaso, London. *Telephone Nos. :* Holborn, 140 and 141.

VISCOSITY OF GLASS. THE EFFECT OF THERMAL TREATMENT.

A new type of apparatus for determining the viscosity of molten glass has been developed at the National Physical Laboratory and is described in a paper presented to the Royal Society* by V. H. Stott, D. Turner and H. A. Soloman. The apparatus was devised in connection with researches into the effects of thermal treatment of glass, and is based upon the measurement of the thickness of the film of glass which adheres to a thin wire of 10 per cent. iridio-platinum, which is withdrawn at a known velocity from the molten glass contained in a small crucible of the same material.

It is stated that the apparatus shows a considerable advance over previous viscometers for molten glass, not only from the point of view of precision (± 3 per cent. of the viscosity) but because it renders possible prolonged experiments on the same specimen of glass, which, if required, may be cooled to room temperature and reheated an infinite number of times.

As just mentioned, the object of the authors was an investigation of the effects of the thermal treatment of glass and they found that, "In the case of the particular glass experimented upon, it was shown that, once homogeneity has been attained at a high temperature, its viscosity at temperatures above 1,200° is repeatable to ± 3 per cent. This holds so long as the composition of the glass has not been changed by volatilisation, and this is inappreciable except at extremely high temperatures. The viscosity at temperatures above 1,200° is unaffected by cooling the glass to room temperature and reheating, provided that the glass be not held too long within a certain critical temperature range which is below 1,200°.

At temperatures below 1,200° it appears that the glass is capable of existing in at least two states, resulting in considerable variation of viscosity. The mean viscosity in this case is that which would be anticipated from an extrapolation of the curve from temperatures above 1,200°. In certain circumstances it is possible to obtain the glass at temperatures below 1,200° in a metastable state similar to its state at high temperatures. In this case the viscosity temperature curve is continuous, and of the same precision throughout.

These observations may have an important bearing on certain phenomena which are well known to the glass maker. Numerous observations have been made which show that many properties of glass, including brittleness, and more particularly the complex factors which govern its mechanical behaviour during working, are influenced by variations in the conditions of founding which are without effect on the final chemical composition. Such variations may be, for example, changes in the moisture content of the batch, differences of heat treatment, or variations in the proportions of cullet added to the batch."

In the original paper, a full description of the apparatus is given together with a detailed exposure of its theory and a record of the experiments carried out in connection with the above mentioned investigations.

---

* Proc. Roy. Soc. No. A762. pp. 499.

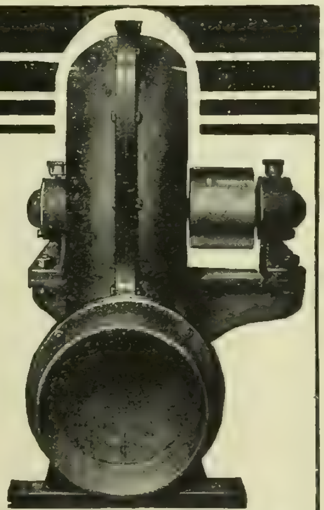
GASIFIED FUEL.

The use of pulverized coal for the heating of boilers and certain types of furnaces has produced some extremely interesting results, both from the financial point of view in reduced fuel costs, and also from the ease and facility of operation of the equipment. Like most innovations, the process has suffered as a result of being applied to installations for which it was not suited, and also from the unsubstantiated claims and figures put forward by unqualified supporters, etc.

As far as glass furnaces are concerned, the inherent defect of the system is the question of the ash content of the coal. If the coal is gasified in producers the ash of course remains behind as clinkers, but when pulverized and then burnt the ash then appears as a fused slag, and if the fuel was projected into a tank furnace this fused ash would of course contaminate the metal.

The process has been applied to a pot furnace, the flames coming through the "eye" in a similar manner to when gas was employed.

A method of using pulverized fuel in such a way as will probably result in obviating the slag or ash difficulty just mentioned has been devised by a Mr. E. S. Suffern. This depends on partially burning the pulverized fuel in a separate chamber with insufficient air for complete combustion, and then completing the combustion of the resulting gases in the furnace proper. In other words, it is a process of gasifying pulverized fuel, and an experimental plant is now in operation, though not in connection with a glass furnace.

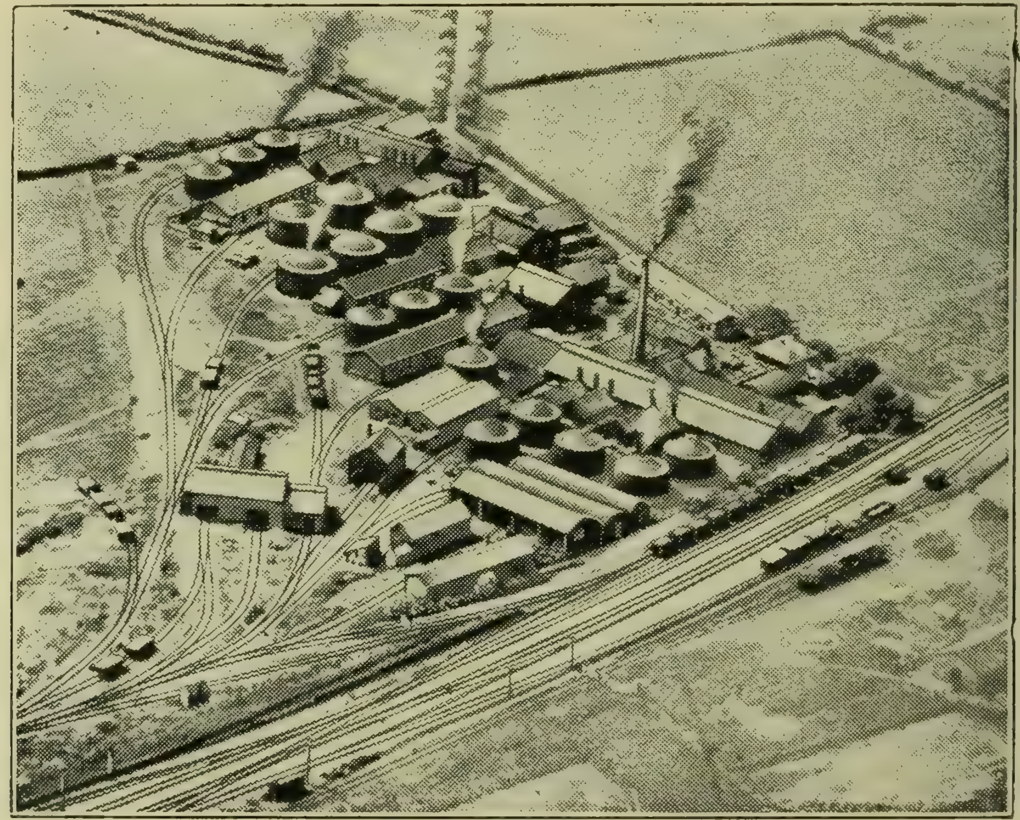


Don't Rob
your main Compressor— make it a
***Sturtevant Fan** to cool your Moulds. More satisfactory from every view-point.*
Write for complimentary Catalogues— ***GL 1019 GL 1241***
STURTEVANT
ENGINEERING Co. Ld.
149, Queen Victoria St.,
LONDON
E.C. 4
N 296.

THE MOST DURABLE **BRICK**
MADE FOR **GLASS FURNACES.**

STEPHENS SILICA "C"

EXTREMELY REFRACTORY, TOUGH AND DURABLE.



VIEW TAKEN FROM AN AEROPLANE.

Kiln Capacity 1½ Million Bricks. Works Cover over 9 Acres.

SUPER SILICA CEMENT for setting SILICA BRICK.

Used by most of the principal GLASS WORKS.

STEPHENS & CO., KIDWELLY.

The Selection and Application of Oil Burners for Use in the Glass Industry.

By W. A. HUBBARD.*

As in 1921, the present coal crisis has directed the attention of manufacturers in various industries to oil fuel as a substitute for coal, and those who have not closely followed the progress of oil firing during the interval, cannot fail to be impressed with the remarkable improvement in the oil firing equipments that are being marketed to-day.

During the 1921 stoppage, the market was flooded with a multitude of oil burning appliances, and without expert advice it was very difficult for the manufacturer to distinguish between the crude and inefficient, and the scientifically designed and efficient plants.

To-day, however, the user can choose between a number of systems, which have been successfully competing with solid fuel during the five years interval of peace in the coal industry; this interval having seen the passing of many of the more crudely designed equipments.

Two factors, however, that caused a lot of failures with oil fuel in 1921, exist to-day. Namely, the selection of the type of burner best suited to the particular type of plant to be converted, and its correct application.

As applied to the glass industry, the first problem must of necessity be settled on economical grounds, and on the score of economy the low pressure air operated oil burner has the advantage of lower initial running and maintenance costs, and it is the application of this type of burner that the writer proposes to discuss.

Tank Furnaces.

Most of the tank furnaces in use to-day, where employed for the manufacture of hand or machine made ware, can be successfully fired with oil, the burners either being set at each side and firing across the tank, or applied at the charging end, each side of a central doghouse.

When firing glass tank furnaces, it is essential that a wide angle flame is produced as a localised jet of flame results in parts of the furnace being at the desired temperature, whilst other parts are comparatively cold, with the result that the metal does not run freely and the brickwork in the crown and sides of the furnace are subject to varying temperatures resulting in uneven expansion and contraction.

Side firing tank furnaces is usually applied where a quick conversion to oil is desired, and in such cases the existing regenerators are used with oil fuel in a somewhat similar manner to gas firing.

Where a tank furnace of average size is being permanently converted to oil, firing at the charging end possesses many advantages and is to be recommended. When firing furnaces in this manner it is usual to dispense with the regenerators and pass the secondary air through recuperators situated above the crown of the furnace, the application embodying an arrangement for controlling this secondary air temperature.

The introduction of this secondary air is of the utmost importance as a thorough mixture of the atomised oil and air depends to a great extent on this point, and unless this factor is carefully considered, perfect combustion, so important when manufacturing white glass, will not be obtained.

The efficiency of tank furnaces when fired either with oil or solid fuel depends to a great extent on the furnace output, it having been proved in practice that when a furnace is worked at maximum output fuel economy is affected.

With oil firing, it is possible to produce from two to four tons of finished glass per ton of oil burned, these figures having been obtained on several furnaces.

As a typical example of the results obtained with oil fuel, I would instance a tank furnace 25′ 6″ long × 8′ 6″ wide with 2′ 6″ depth of metal. A Lynch machine was attached to this furnace, producing 100 gross of 25 oz. whisky bottles per 24 hours. The oil consumption on this furnace was approximately 35 gallons per hour, or one ton of oil was producing three tons of finished glass. Much, however, depends on the design of the furnace, and these figures have been exceeded in many installations.

Pot Furnaces.

The conversion of pot furnaces to oil firing is a rather more difficult proposition. The usual method that has been adopted for firing these furnaces as an emergency measure during the present coal stoppage has been to insert the burners so that the flames are projected tangentially around the furnace above the pots, but the type of burner selected should be chosen with care. The flame will be in close proximity to the crown and expensive repairs may result if the burner is of the type giving an intense local heat.

Another emergency application is to remove one pot and fire straight into the furnace, the space previously occupied by the pot forming the combustion chamber. Two burners are fitted so as to operate with as short a flame as possible.

In view of the even heating that is necessary in this type of furnace in order to assure a reasonable life for the pots, the most satisfactory method is to fire these furnaces centrally below the siege, the oil flames entering the furnace in a very similar manner to the flames when gas fired.

---

* Assisant Manager, Combustions Ltd.

PARKINSON & SPENCER, Ltd.

Ambler Thorn Fireclay Works,
HALIFAX, YORKSHIRE.

ESTABLISHED
1800.

Telephone : No. 1207.
Telegrams : Parkinson & Spencer, 1207 Halifax

Manufacturers of Refractory Goods of every description for the Glass industry, viz:

GLASS-HOUSE POT CLAY, FIRE CLAY, FIREBRICKS, TANK BLOCKS, BINDERS, etc.

Our Tank Blocks are unsurpassed for quality and durability.

WE SPECIALIZE IN BEST POT CLAY MATERIAL.

New Plant recently erected for the cutting and dressing of Tank Blocks to any dimensions.

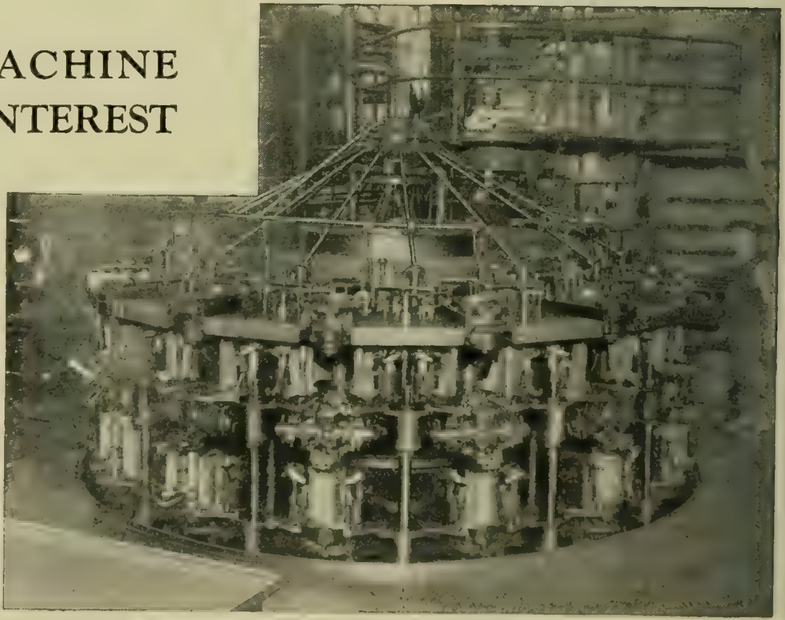
FAVOUR US WITH YOUR ORDERS AND YOU WILL BE SATISFIED WITH RESULTS.

NEW GRAHAM MACHINE CREATING GREAT INTEREST

Offers unusual advantages because of improved construction. Eliminates intermittent rotation which causes wear and tear through jerking. Continuous rotation permits larger production and lower operating costs.

Flexibility of operation appreciated. Produces both narrow and wide mouth bottles in wide range of sizes. Makes push-up bottoms without separate operation.

Three sizes of same construction.
AZ Machine, 15 blank and 15 blow molds
AY Machine, 10 blank and 10 blow molds
AY6 Machine, 6 blank and 6 blow molds
Molds and mold operating parts are interchangeable.



AZ Flow Type—Maximum Speed 72 Bottles per Minute

THE OWENS BOTTLE COMPANY—TOLEDO, OHIO, U. S. A.

Ask us for illustrated catalog, giving complete information.

Annealing Lehrs.

So many and varied are the designs of annealing lehrs in use in various parts of the country that it is very difficult to standardise the application of oil burners for lehr firing, the only satisfactory way being to consider each job on its merits, and to decide on the application from previous experience. The chief point to be borne in mind in this case is that the flame be of low velocity and a burner selected that does not produce intense local heat.

When designing lehrs specially for oil firing, a single combustion chamber is found to give good results, the gasses being led to the conveyor chamber, or to the muffle by means of ports suitably placed and of varying cross sectional area.

In order to give the required temperature gradient, the area of these ports must be carefully considered, and in most instances it is necessary to provide some means of regulating this area in order that the ports can be adjusted and the final size arrived at after the lehr has been operating under working conditions.

Where a lehr is heating one particular class of ware there seems no reason why a thermostatic control should not be introduced, designed to maintain a practically constant temperature at a given point in the lehr.

Glory Holes.

Before concluding, the writer would like to say a few words on glory holes which still exist in many works and appear to be a source of wasted fuel.

The writer has in mind a case where a glory hole was fitted with two oil burners each consuming from 3½ to 4 gallons per hour. Only two small working holes were fitted, and undoubtedly this furnace should have been operating successfully with less than half the above oil consumption.

The construction of a glory hole being a comparatively simple matter, it is certainly the policy when installing oil fuel on this type of plant to construct one specially for oil firing in accordance with the oil burner manufacturers' recommendation.

◆

The Autumn Programme of the Institution of Fuel Technology has been approved by its Council. The meeting will extend over two days—Tuesday and Wednesday, December 7th and 8th. On the first day Sir Alfred Mond will deliver his presidential address, and an inaugural dinner will be held in the evening. The authors of papers are famous in the world of science, and the papers to be presented are of the utmost significance. The list of authors and papers is as follows :—Prof. W. Groume Grjimailo, The University of Moscow, "Laws of Gas Flow in Furnaces"; Sir Richard Redmayne, K.C.B., " The Occurrence, Working and Treatment of Brown Coal" ; Sir John Biles, " Steam Power Production " ; Prof. J. Tausz, The University of Karlsruche, " The Hydrogenation of Liquid Fuel" ; Prof. R. T. Haslam, The University of Massachusetts, U.S.A., " The Combustion of Carbon" ; Mr. T. Hardie, Chief Engineer to the Gas Light and Coke Company, Limited, " Practice in Gas Manufacture " ; Dr. J. S. Owens, Superintendent, The Advisory Committee on Atmospheric Pollution, " Smoke and Public Health."

Oil Fuel *for* Glass Furnaces

Oil-fired furnaces for glass melting have been installed in the principal glass works during the past few years—to take the place of furnaces fired by other kinds of fuel. The results have been entirely satisfactory—giving a much quicker rate of melting, more uniform heating of metal, cleaner work, absence of smoke and ashes, economy in labour, and lower working costs.

Ample supplies of Mex Fuel Oil at normal prices are available for immediate delivery to any part of the country. There is no restriction on supplies.

Our technical experts are at your service for free consultation and advice. Write to the address below.

MEX FUEL OIL

Shell-Mex Ltd. (Fuel Oil Dept.), Kingsway, London, W.C.2.

TELEGRAMS:
"GLASMACHIN, ESTRAND, LONDON.
CABLES:
"GLASMACHIN, LONDON"
CODE:
BENTLEY'S.
TELEPHONE:
CENTRAL 5985.

C. SAXTON, A.M.I.E.E., M. IRON AND STEEL INST., Etc.

CONSULTING ENGINEER

Talbot House,
Arundel Street,
Strand, London, W.C.2.

BOTTLE MOULDS

ORDER YOUR MOULDS FROM

E. LUNN & Co., MOUNT STREET, GLASGOW.

Largest MAKERS of MOULDS in the UNITED KINGDOM

Quick Deliveries and Complete Satisfaction Guaranteed.

MOULDS FOR ALL TYPES OF MACHINES SUPPLIED

ALL MOULDS MADE OF CHILLED CASTINGS ONLY.

Telephone— WESTERN 2792.
Telegrams— GLASMOLD, GLASGOW.

ONE OF OUR RECENT TESTIMONIALS—

"We have one set of Ordinary Round Quart Moulds which you supplied to us which have been working for 2½ years. These are still in perfect condition, showing no cracks or any other flaw in the metal. They have been working almost continuously for the above period, only being off the machines for a week or two at a time. We have also other moulds in Square, Oval and special shapes which have been working quite as long as the Ordinary Round Quarts, although not so continuously, and these also are in perfect condition. We have always found your moulds more satisfactory than any others, and the metal you use is much more durable than any supplied by other firms."

Reference on our Testimonial File: A.B. 91.

Trade "TWENTY MULE TEAM" Mark

Granulated

BORAX

Specially refined for
ENAMELLERS AND POTTERS

BRITISH MANUFACTURE.
Guaranteed 99·50/100% pure.

Entirely free from phosphates.

BORAX CONSOLIDATED LTD,
16, Eastcheap, LONDON, E.C.3.

TRADE NOTES.

Messrs. Industrial Combustion Engineers, Ltd., advise us that they have changed their address to 31-37, Wybert Street, London, N.W.1, as and from September 29th.

◆ ◆ ◆

The Wellman Smith Owen Engineering Corporation, Ltd., announce that they have now removed to larger premises at Victoria Station House, Victoria Street, London, S.W.1. Telephones: Victoria 7752, 7753, 7754. Telegrams: Principium, Sowest, London.

◆ ◆ ◆

According to the programme for the London Section of the Society of Chemical Industry, Professor W. E. S. Turner is to give a paper on "Recent Progress in the Glass Industry," before the Society on March 7th, 1927.

◆ ◆ ◆

As and from October 1st, freights on the Belgian railways are to be further increased by 25 per cent.

◆ ◆ ◆

The Society of Glass Technology.

The Society of Glass Technology will hold the first meeting of the new session in the Fuel Lecture Room of the University, Leeds, on October 20th, 1926. This meeting is to be devoted to a discussion on annealing. The following papers will be presented: (a) "Annealing," by E. A. Coad-Pryor, B.A.; (b) "The Principles of Annealing," by Dr. J. W. French; and (c) "The Relationship between Chemical Composition and the Upper Critical Annealing Temperature of Glasses," by Dr. S. English, and Professor W. E. S. Turner.

The subject under discussion is one of vital importance and interest to every one connected with the successful production of glassware, and it is hoped that members of the Society will make every possible effort to attend the meeting, and take part in the discussion.

◆ ◆ ◆

On October 11th, at 7.30 p.m., Prof. H. B. Dixon will read a paper on the "Ignition of Gases," before the Ceramic Society, at the Central School of Science and Technology, Stoke-on-Trent.

◆ ◆ ◆

The directors of the United Alkali Company have decided that, in view of the continuance of the coal stoppage, no interim dividend will be paid on the £900,000 ordinary capital.

◆ ◆ ◆

A dividend of 17½ per cent. for the year has been recommended by the directors of the Glenboig Union Fireclay Co. For the year 1924-25 the dividend was 20 per cent.

◆ ◆ ◆

The accounts of Triplex Safety Glass Co., Ltd., for the year ending June 30th, 1926, show a net profit of £22,052. A final dividend of 5 per cent. has been declared, making 15 per cent. for the year. £12,486 is carried forward as against £6,904 brought forward.

According to an American trade journal, there are persistent reports from sources that are considered to be authoritative, that the American Window Glass Company is installing ten Fourcault machines at its Bellevernon factory, and that the production of glass by the Fourcault process is imminent. It is also anticipated that the Company has made improvements to the process as generally operated.

◆ ◆ ◆

Messrs. Bomert, Teves & Blankley, importers of window glass, plate glass, patent plate and silvered sheet glass, etc., advise us that they have removed to larger premises at 11-15, Monument Street, London, E.C.3. Telephone: Royal 6052, 6053, 6054.

◆ ◆ ◆

We understand that Professor W. E. S. Turner has left England for a visit to Canada.

◆ ◆ ◆

The United Glass Bottle Manufacturers, Ltd., have closed down their Castleford factory. A number of the men and some of the equipment has been transferred to other of their works.

◆ ◆ ◆

A number of factories which were managing to continue operating on a reduced scale with imported coal, were handicapped by the dock strike at Hamburg, which held up supplies; consequently there have been further increases in the transformation to oil burning.

◆ ◆ ◆

According to Dr. J. Bell Ferguson, the school medical officer at Smethwick, Birmingham, boys in a classroom equipped with glass which allows the ultra violet rays to pass gained in a period of nine months more than 3 lbs. in weight and over half-an-inch in height as compared with boys in an adjoining classroom which was glazed with ordinary window glass. The Education Committee have decided to equip a number of schools with the new glass.

◆ ◆ ◆

Mr. Ed. Miller, of the Miller Machine and Mould Works, Columbus, Ohio, spent about three weeks visiting numerous factories in England and Scotland. Prior to coming here he had visited many Continental works, and expressed the opinion that he anticipated obtaining good business from the result of his tour.

◆ ◆ ◆

We hear that the new "R" Lynch machine, which possesses numerous improvements on the L.A., is giving very good results in a London factory, and that although only recently introduced a number have been ordered.

◆ ◆ ◆

Mr. A. Howard has been elected Master of the Glass Sellers' Company for the second year in succession. Mr. C. F. Ball has been elected Prime Warden, and Mr. H. B. G. Larkin Renter Warden.

◆ ◆ ◆

A large plant glass factory has decided that by grinding the raw lime at the factory and using it immediately, the melting time and temperature is reduced.

Many Glass Manufacturers
have PROVED the

MANSFIELD

CRUSHERS and
GRANULATORS

to be the BEST for

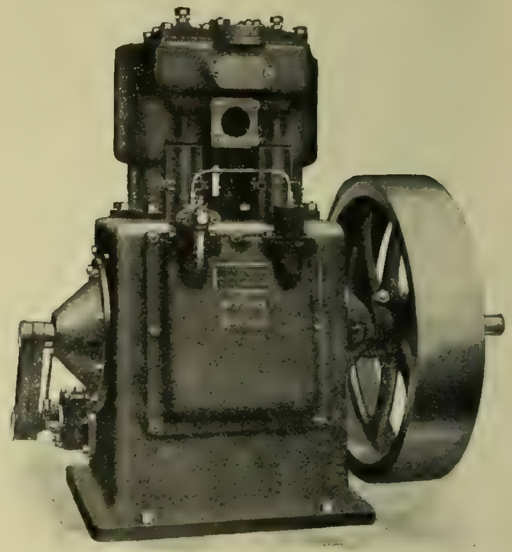
dealing with Manganese Ore,
Limestone, Saltcake, Cullet,
etc., etc.
Materials always remain
GRANULAR irrespective of
size.

FRANK MANSFIELD & CO.,
9, REDCROSS ST., LIVERPOOL.

Telegrams :
PRECEDENCE, LIVERPOOL.

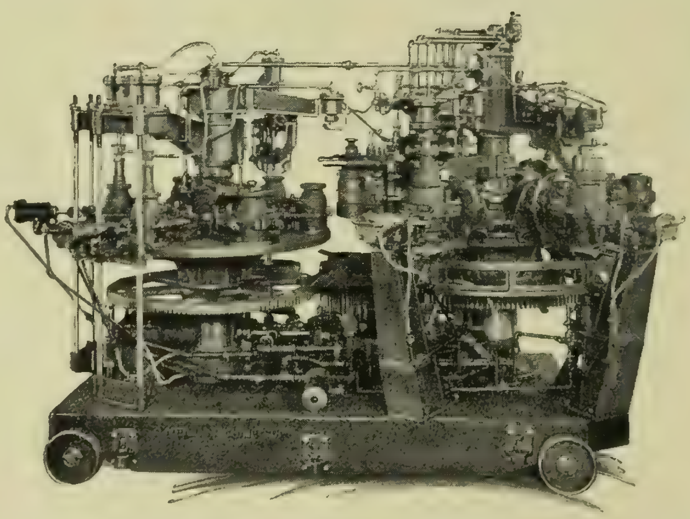
Telephone :
4925 BANK.

"BROOMWADE"



AIR COMPRESSORS
BRITISH AND BEST
FOR ALL DUTIES.

BROOM & WADE, Ltd., HIGH WYCOMBE.



The New O'Neill No. 44
Blowing Machine.

A well-built, high speed blowing machine with a range from 6 oz. to 40 oz. in capacity. Operating speeds up to 23 per minute depending on the class of ware being made. Have our London representative give you the details.

THE O'NEILL MACHINE CO.,
TOLEDO, OHIO, U.S.A.

LONDON OFFICE : 10 SAVOY ST., STRAND, LONDON, W.C.2.

Telephone : Gerrard 7190.

Telegrams and Cables : Oneillany, Rand, London.

The Use of Compressed Air—*Continued.*

By ROBERT WILSON.

Air Receivers.

In nearly all compressed air installations it is required to eliminate the pulsations resulting from the intermittent discharge of air from the compressor cylinder in order to maintain an even flow, at a low velocity, and uniform pressure, in the air distributing pipes. This purpose is effected by leading the air into a "receiver" of greater cross-sectional area than that of the air pipe connecting the compressor and the receiver, and of relatively larger volume, thus greatly reducing the velocity of flow of the air coming from the compressor. This constitutes the primary purpose of the air receiver but there are other useful and valuable functions which the receiver can perform when a little study is given to its size and to its position relative to the compressor.

Size of Receiver.

The size of the air receiver should be determined in relation to the working pressure and to the comparison between the capacity of the compressor and the normal rate at which the air is used. If the consumption of air is constant and uniform and about equal to the capacity of the compressor, no advantage will be gained by having a receiver any larger than the minimum size necessary to eliminate pulsations and maintain a uniform pressure.

If, however, the consumption of air is variable and intermittent the receiver should be relatively large if rapid fluctuations of pressure are to be avoided. If the receiver is small the pressure will rise rapidly when consumption is reduced or stopped, and, inversely, the pressure will fall rapidly if consumption exceeds the output of the compressor. Most makes of air compressors are provided with a device which automatically controls the maximum air pressure, and which, when the pre-determined maximum pressure is reached, unloads the machine and allows it to run light until the pressure in the receiver has dropped a few lbs., when the load is automatically restored and the machine again discharges into the receiver. This system of unloading the compressor when the pre-determined maximum pressure is reached is intended to make for economical operation, but if the fluctuation of pressure is of such magnitude and of such rapidity as to cause the unloading device to be in almost continuous operation the best results cannot be obtained from the compressor. It is better, when consumption is intermittent, that the receiver be of ample size to ensure that the pressure will rise and fall gradually.

There are no fixed rules for determining the size of air receiver best suited to the working conditions, but, since the volume occupied by the air discharged from the compressor is proportionate to the working pressure, the calculated volume occupied by the air discharged per minute should be utilised to help determine the size of the receiver.

The calculation for the volume occupied by the compressed air is easily made, as the following example will illustrate.

Example (1). The capacity of a compressor is 600 cubic feet of free air per minute; working pressure 30 lb. per square inch (gauge). Determine volume of compressed air—assuming equal temperatures for "free" and "compressed" air.

The formula for the calculation is as follows:

$$V_2 = \frac{15 \times V_1}{P_2 + 15}$$

where V_2 = the volume of compressed air per min. in cubic feet.
V_1 = free air capacity of compressor, per min. in cubic feet.
P_2 = working pressure lb. per sq. in. (gauge).

substituting in this formula the values in above example:

$$V_2 = \frac{15 \times 600}{(30 + 15)} = 200 \text{ cubic feet.}$$

Therefore, the volume occupied by 600 cubic feet of free air when compressed to 30 lb. pressure per sq. in. (gauge) is 200 cubic feet.

If the use of the air is comparatively constant and uniform a receiver having a volume equal to the volume occupied by the pressure air will be amply big to perform the functions of eliminating pulsations and steadying the pressure, but if the use of the air is intermittent, the size of the receiver, where possible, should be larger. There is really no limit to the size, other than the limitations on handling and accommodating—and as a rule these limitations eventually prescribe the dimensions and form of the receiver. For general guidance, however, and where the use of the air is intermittent, the receiver should have *a capacity equal to about three times the output of the compressor.*

Applying this general rule to the example given above the respective sizes of receivers, for "constant" and "intermittent" use of the air, would be as follows:

Constant use .. 200 cubic ft. (equal to the volume of a receiver 4′ 6″ dia. × 12′ 6″ high or long).
Intermittent use .. (3 × 200) = 600 cubic ft. (equal to the volume of a receiver 6′ 3″ dia. × 20′ 0″ high or long).

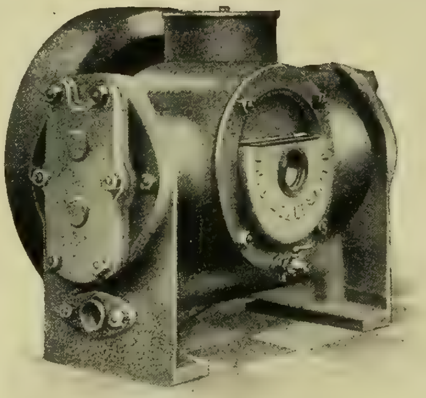
In the average glass works the rate at which the air is used is comparatively constant, so that the receiver need not be so large as the size prescribed for "intermittent" work. Since, however, the consumption *is* liable to slight variation, and as the capacity of the compressor may not be exactly equal to the normal rate of consumption, it is advisable to have the receiver larger than the size suggested for "constant" work. The reserve of air which can be stored in the larger receiver reflects beneficially in the operating costs, as, since the rise and fall of the pressure will be more gradual, the compressor will run for long periods on light-load, and

AIR COMPRESSORS
& VACUUM PUMPS

As Illustrated
in 5 sizes
from
10 to 80
cubic feet per
minute

Other types
Larger sizes

Any Pressure
or Vacuum



LACY-HULBERT & CO., LTD.

BOREAS WORKS, BEDDINGTON
NR. CROYDON, SURREY
Telephone: CROYDON 1698.

Moulds

Machined to specification from finest crucible chilled castings by highly skilled craftsmen; our works equipment ensures accuracy and superiority of finish.

SPECIALITIES—

Mould equipment for **Lynch, Miller, O'Neill** and other Automatic Machines.
Glassworks Patterns, Crucible Iron Castings.

ALL ORDERS EXECUTED PROMPTLY.

Johnson Radley & Sons, Ltd.,
Chesney Works, Hunslet, LEEDS.

Telegrams—MOULDS, LEEDS. Telephone—LEEDS 21354.

TECHNICAL BOOKS.

The following are of special interest:—

A TEXTBOOK OF GLASS TECHNOLOGY.
Hodkin & Cousen. 551 pp. 251 Illustrations.
42/- net.

MODERN GAS PRODUCERS.
N. E. Rambush. 545 pp. 356 Illustrations.
55/- net.

THE FLOW OF GASES IN FURNACES.
Groume-Grjimailo. 397 pp., including Appendix on Furnace Design.
27/6 net.

OIL FUEL.
Its Supply, Composition and Application.
E. Butler. 4th Edition. 310 pp. 158 Illustrations.
12/6 net.

INDUSTRIAL FURNACES.
W. E. Trinks. Vol. 1. 2nd Edition.
22/6 net.
Vol. II. 405 pp. 292 Illustrations.
27/6 net.

THE DECIMAL PLATE AND SHEET GLASS CALCULATOR.
Samuel S. Lindsay,
Comptroller of the Pittsburgh Plate Glass Company.
29/6 net.

One large glass company estimate they are saving £600 a year in one department by the use of this book.

ANY Technical Book can be obtained from—

GLASS PUBLICATIONS, LTD.,
Talbot House Arundel Street,
Strand, LONDON, W.C. 2.
Telephone: Central 5985.

the periods of full and light-load running will be more uniform.

Power Reserve.

The extent to which the air stored in the receiver serves as a "reservoir of power" is inclined to be misunderstood and exaggerated. From the examples already given—to indicate the probable proportions of the receiver—it is apparent that the storage capacity of the receiver, compared with the rate at which the air is used, is very limited, and too small to be of much practical service as a reservoir of power. For example, the volume of a receiver which, when filled with air at a pressure of 30 lb. per sq. in. (gauge), could maintain a regular consumption of 500 cubic feet of free air per minute for only *two* minutes after the compressor was stopped, and not have the gauge pressure fall below 20 lb. per sq. in., would require to be about 1,400 cubic feet capacity, equal to the volume of a receiver 6′ 0″ dia. × 50′ 0″ long, a size which is quite unpracticable for such a small regular consumption.

It will be apparent, therefore, that the energy stored in the receiver cannot be regarded as of much practical service, but just as the engine flywheel stores the energy required to maintain uniform speed, so a receiver, having a storage capacity greater than the normal output of the compressor per minute, will store that energy which will preserve uniform pressure should the consumption momentarily exceed the supply from the compressor.

Position of Air Receiver.

Another important function of the air receiver is to cool the air so that some of the moisture and oil carried over with the air will be collected in the receiver where it can be drained off at intervals. It is commercially impracticable in small plants to eliminate moisture from the air, and when the air is compressed the moisture is present in greater proportion per cubic foot. The only means of separating the moisture and oil from the air is to cool the air, but as the air leaving the compressor is very hot the receiver would require to be placed some distance away from the compressor, and in a cool place, if the air, when passing through the receiver, is to be cold enough to cause some of the moisture and oil to separate from the air and drop to the bottom of the receiver.

It is, however, also important that the receiver be placed not too far away from the compressor, for the reason that the frictional resistance in the discharge pipe is considerable, and increases as the pipe lengthens, the cause of this being the high velocity of the air and the periodic pulsations.

In some plants it is difficult to reconcile both these requirements, and where, in order to effect cooling of the air, the receiver has to be placed more than 50 feet away from the compressor, it is advisable to place a small auxiliary receiver close up to the compressor and position the main receiver where it will be surrounded by cool air. The auxiliary receiver, indeed, is worth while in the majority of cases, since it not only diminishes the momentary rise of pressure caused by each stroke of the piston—by lessening the frictional resistance in the discharge pipe—but also reduces the frictional resistance in the pipe connecting to the main receiver—by virtue of lowering the velocity of flow in this pipe—and, best of all, gives freedom to place the main receiver in the position best suited for the cooling of the air and separating of the moisture. Moisture laden air is unsuited for glass blowing, and where facilities are provided for removing some of the moisture the effect is reflected in better production.

Where the receiver is insufficient for the purpose of trapping the moisture an after-cooler may be used, or separators may be placed in various positions throughout the pipe system. An after-cooler is constructed similar to an inter-cooler and is equipped with nests of tubes through which water circulates. They are expensive to make and for this reason are sparingly used.

Construction of Air Receivers.

The common type of receiver consists of a cylindrical shell of steel plate with dished ends arranged to be set down vertically or horizontally. The receiver is provided with flanges for connecting to the pipes leading from the compressor, and to the distributing mains, and should be complete with the following fittings:—Pressure gauge, relief valve, man-hole, and drain cock. The man-hole should measure at least 15″ × 11″, this being the minimum size acceptable by insurance companies. The drain cock should be placed near the bottom so that the moisture and oil separated from the air can be drawn off at intervals. The construction of the shell depends upon the surface area and the working pressure, but as a rule the dished ends are thicker than the shell, the circumferential seams are lapped and single-riveted, the longitudinal seams lapped and double-riveted, and all seams caulked to render them air-tight. The receiver, when complete, should be tested by hydraulic pressure to twice its working pressure, and should be guaranteed tight under air at 25 per cent. excess working pressure. Sometimes a valve is supplied on the outlet branch. This should be of the "wedge gate," or sluice, straight-through type, in preference to the "stop valve" type. It is not advisable to have any type of screw-down valve on the inlet branch, and should a valve be necessary in this position it should be of the automatic check type. The inlet and outlet branches should be positioned to suit the lay-out of compressor, receiver and piping.

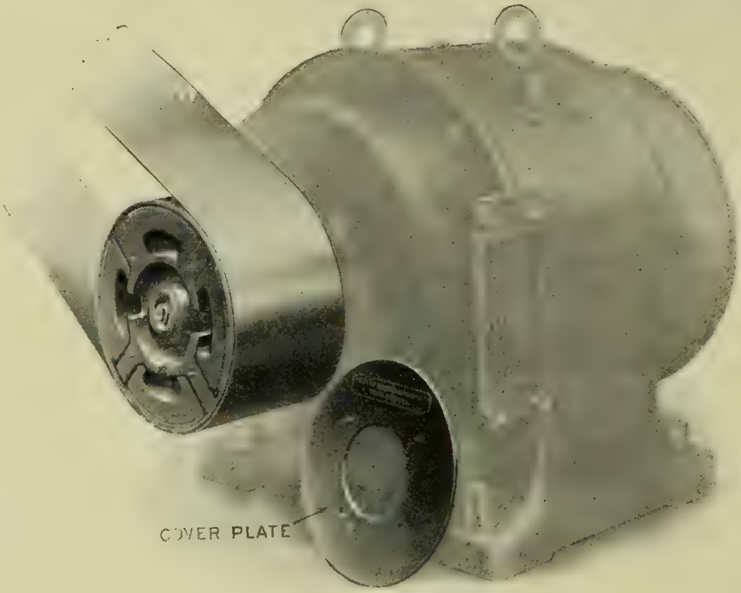
Receivers are made in stock sizes, but most makers will make up sizes to customers' requirements.

◆◆◆

The use of plate glass for the windows of private residences and buildings of a similar nature has been restricted in the past by the fact that the usual minimum thickness of polished plate was one-quarter of an inch and weighed approximately 3.5 lbs. per square foot.

The Pittsburgh Plate Glass Company now state that they have developed a new process at their Creighton, Pa., factory, which is pre-eminently suitable for producing thin plate, and they are now manufacturing in commercial quantities one-eighth inch polished plate, which will sell at the same price as the quarter.

"BROADBENT"
PATENT AUTOMATIC CENTRIFUGAL
CLUTCHES.



A "Broadbent" Automatic Clutch Pulley for Belt Drive.

Should always be fitted to Electric Motors.

ADVANTAGES:

Enables Motor to Start up easily against Full Load.
Entirely Dispense with Fast and Loose Pulleys.
Safe Protection for Motor against Overload.
Cheap Motors and Star-delta Starters can be used.
Considerably Reduce Starting Current Consumption.
Entirely Automatic.

Used by most of the Leading Firms throughout the country.

New Catalogues post free.

Thomas Broadbent & Sons, Ltd.
ENGINEERS
HUDDERSFIELD.
The Largest Makers in the World.

TORPEDO *and* **WASP-SHAPE** **TANK FURNACES**

(Designed under Moorshead's Patent No. 227,939)

Constitute the LATEST PROGRESS in Tanks.

INCREASE LIFE OF BLOCKS
Avoid stagnant metal.
Save fuel as the corners do no melting.
Ensure smooth running.

By arrangement with Messrs. U.G.B., I can now supply customers in Great Britain and Ireland with these modern types, WHICH ARE SUPERSEDING THE OLD SQUARE TANKS AT MESSRS. U. G. B. Co.'s UP-TO-DATE WORKS AT CHARLTON & ST. HELENS, etc.

Send for full particulars and let me quote for altering your old tanks.

TH. TEISEN, C.E.,
FURNACE ENGINEER,
20a, TEMPLE STREET, BIRMINGHAM.
Telephone : Central 1806. *Telegrams : "Tete, Birmingham."*

THE SELECTION OF ELECTRIC MOTORS

(*continued.*)

In the present notes it is proposed to deal with the "slip ring" type of alternating current motors which differ from the squirrel cage machines only in the arrangement of the windings of the rotor. In this case the ends of the windings are brought out and connected to slip rings mounted on, but insulated from, the motor shaft and one another. This is done in order that external resistance may be connected in the rotor circuit for starting purposes, speed regulation, etc. The electrical connection is made by means of brushes, usually carbon or copper carbon, which rest upon and make rubbing contact with the rotating slip rings.

With regard to starting characteristics of slip ring machines, they possess an advantage over the squirrel cage type in that they will exert full load or more than full load torque at starting, with the starting current approximately equal to that of full load or the corresponding overload. This is effected by inserting a starting resistance in the rotor circuit through the medium of the slip rings and brushes just mentioned. The motors, if necessary, will at starting exert twice full load torque, with a starting current of about two-and-a-half times that of full load.

When the motor has run up to speed the external or starting resistance can be short circuited. This is done by an attachment fitted to the slip rings which enables them to be short circuited, thus eliminating losses which would otherwise occur in the connecting cables between the slip rings and the starting resistance, and also brush contact resistance losses. It is further possible to have fitted a device which lifts the brushes off the slip rings after the latter have been short circuited. This has the effect of saving the wear on the rings and brushes, but these two operations, generally combined in one device, are, as a rule, only fitted when the machines run for fairly long intervals without stopping. If the motor is to start and stop frequently they become a nuisance, because if the rings are shorted and the brushes lifted after the machine has taken up the load, and it is afterwards stopped by opening the main switch, it is impossible to start it again until the brushes are lowered and the short circuiting device opened. Where the motor is in close proximity to the starter, this presents no real inconvenience, but if, as often happens, the motor is some little distance from the starter, these attachments are best avoided where conditions necessitate frequent starting and stopping.

To consider now the question of speed. At no load the speed of these motors depends entirely upon the frequency (number of cycles per second) of the supply circuit in exactly the similar way to the squirrel cage motors dealt with last month. The same formula holds good:

$$S = \frac{120 \times F}{P}$$

where S = no load speed in r.p.m.
F = frequency in cycles per second
P = number of poles

Also with no external resistance in the rotor circuit, the full load speed will be almost identical with that of a squirrel cage machine, i.e. from 2 to 3 per cent. less than no load or "synchronous" speed for the larger sizes to 6 or 7 per cent. for the smaller machines. This drop being again referred to as the "slip" and is usually expressed as a percentage of the synchronous speed.

With all starting resistance cut out a slip ring motor behaves very similarly to a continuous current shunt wound machine as far as speed is concerned.

One advantage of the slip ring motor is that it is possible to vary the speed of the machine by means of resistance in the rotor circuit, the greater the resistance the lower the speed. In this way a considerable range may be obtained. Under these conditions, however, the machine loses its shunt characteristics and behaves like a D.C. series motor, a change in load causing a corresponding but inverse variation in speed. It should be mentioned, however, that this method of obtaining speed variation is inefficient, and wasteful if it can be avoided, as the efficiency of the motor is reduced almost in equal ratio with a reduction in speed.

Another method of varying the speed in the case of special machines is by varying the number of poles as was described in connection with the squirrel cage motors last month.

(*To be continued.*)

COMPLETE PYROMETER EQUIPMENT FOR GLASSWORKS.

The "Resilia" construction, exclusive to Foster Pyrometers, ensures reliable service under the worst conditions. Let us give you full information on this and other special features embodied in our instruments.

FOSTER INSTRUMENT CO.,
LETCHWORTH, HERTS.
"The Pyrometer People."

Telephone: Letchworth 26.
RESILIA
Telegrams: "Resilia, Letchworth."

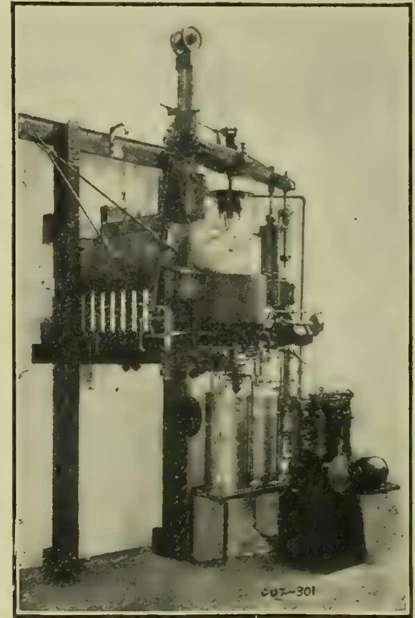
British Instruments for British Industries.

MODEL KFO.

LATEST
MILLER
FEEDER

卐

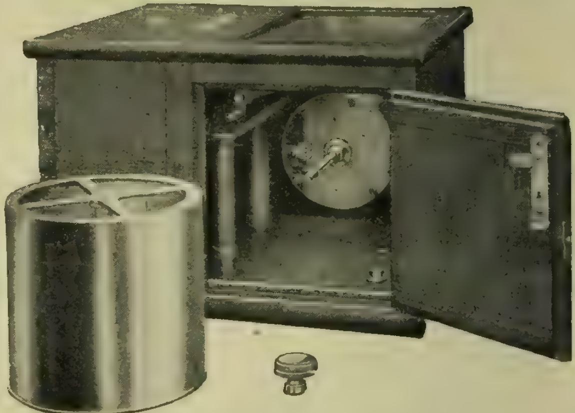
PROGRESSIVELY
DEVELOPED
SINCE 1907.



WILLIAM J. MILLER, INC.
SWISSVALE, PA., U.S.A.

London Office: 366 STRAND, LONDON, W.C.2 Tel. No.: REGENT, 5647.
Cable Address AUTOGLASMA, RAND, LONDON & AUTOGLASMA, PITTSBURG, PA.

SIEMENS
TEMPERATURE RECORDER

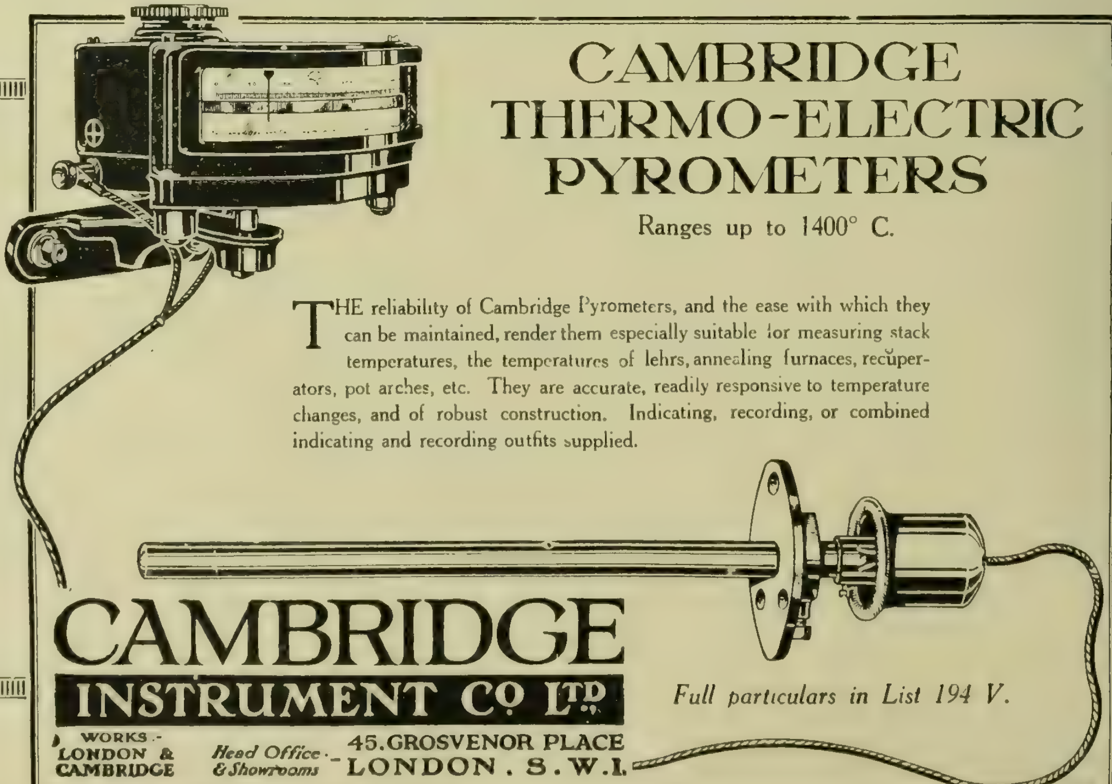


Drum Recorder, Type M.V.R.G.

This Recorder gives a permanent record of temperature variations on a clockwork-driven drum, which rotates once in 24 hours. No batteries are required.

Further particulars and pamphlets on application.

SIEMENS BROTHERS & CO., LTD.,
WOOLWICH, S.E.18.
ESTABLISHED 1858.



CAMBRIDGE
THERMO-ELECTRIC
PYROMETERS

Ranges up to 1400° C.

THE reliability of Cambridge Pyrometers, and the ease with which they can be maintained, render them especially suitable for measuring stack temperatures, the temperatures of lehrs, annealing furnaces, recuperators, pot arches, etc. They are accurate, readily responsive to temperature changes, and of robust construction. Indicating, recording, or combined indicating and recording outfits supplied.

CAMBRIDGE
INSTRUMENT Cº Lᵀᴰ

WORKS:-
LONDON &
CAMBRIDGE

Head Office & Showrooms - 45, GROSVENOR PLACE
LONDON . S.W.1.

Full particulars in List 194 V.

12 2582

Catalogues.

Centrifugal Clutch Pulleys. A 40-page booklet received from Messrs. Thomas Broadbent & Sons, Ltd., Huddersfield, is devoted to their patented automatic centrifugal clutch pulleys and couplings. The principles of operation are clearly described with the aid of drawings, whilst the advantages obtainable from their adoption are set out.

By means of sectional drawings the prospective user is assisted to determine the type best suited to his requirements and numerous illustrations are given of actual installations. Several useful tables on power transmission are also included.

Low Temperature Carbonisation. The "Salermo" Process. Many different processes for the low temperature carbonisation of coal have been brought before the notice of technical men and also, often to their sorrow, of the investing public. In a brochure received from Messrs. Salermo, Ltd., Imperial House, Kingsway, London, W.C.2, a large number of these are briefly described and details given of the results obtained. In addition a clear synopsis of the aims of low temperature carbonisation is given, so that, although issued by the Salermo company, the book really forms a fairly concise guide to the process in general. About eight pages only are devoted to a description of the "Salermo" process, which is already in operation in the Saar, the results obtained being such that a further plant to deal with ten times the quantity per day of the original installation has been ordered.

Gravity Conveyors. An illustrated leaflet from Messrs. Herbert Morris, Ltd., Loughborough, shows numerous installations of their gravity conveyors.

Tumbler Switches. Many types of tumbler switches are illustrated, described and priced in a 20-page booklet received from the Wandsworth Electrical Mfg. Co., Ltd., Imperial Works, Ludgate Hill, Birmingham.

Silica-Graphite Paint. Descriptive leaflets received from Messrs. C. R. Averill, Ltd., 22, Duke Street, Stamford Street, London, S.E.1, deal with the silica-graphite paints which the company manufacture in London, under licence from the Joseph Dixon Crucible Company. This paint is specially prepared for the protection of iron and steel work exposed to corrosive atmospheres and conditions.

Motor Control Gear. Leaflet No. C.L.83, from George Elleson, Perry Bar, Birmingham, illustrates a few examples of a new range of circuit breakers and starting gear for small and medium sizes of electric motors. The apparatus is all of the iron-clad type and incorporates the special features for which the firm is well known.

Drawing Office Equipment. From Axene, Ltd., Maxwell House, Arundel Street, London, W.C.2, we have received a leaflet describing their patented magnetic tee-squares and drawing boards. The boards are fitted with a rustless steel working edge, and the tee-square has a stainless steel magnetic working edge; the result is that the tee-square retains itself dead true to position and virtually provides a third hand for the draughtsman. This we can vouch for from personal use.

Sand Blast Apparatus. An exceedingly well produced catalogue of this equipment is to hand from Telghman's Patent Sand Blast Co., Ltd., Broadheath, Manchester; the many types of apparatus are illustrated and described, including a number which have been specially designed to suit various branches of the glass industry. Amongst a list of some users of this apparatus we notice numerous well-known names in the glass trade.

Glassware.—It is no exaggeration to say that the new catalogue just issued by Messrs. Ackroyd & Best, Ltd., Morley, Leeds, is one of the most comprehensive and best produced that we have ever seen in connection with glassware. It covers every type of illuminating ware both domestic and industrial, there being hundreds of illustrations of different shapes, decorations, etc. Table and ornamental glass are also included, together with multitudinous types of pressed and miscellaneous ware; in fact, apart from containers and flat glass, the catalogue covers almost every requirement in the shape of industrial or domestic glassware.

A point of special interest is that all the goods in the catalogue are made at the company's works at Morley. The company are to be congratulated on their initiative in publishing such an excellent production, as are also the printers, the coloured illustrations, of which there are many, being exceptionally good.

Messrs. Ackroyd & Best inform us that the price list for use with the catalogue will be ready in the course of two to three weeks.

◆

AUTUMN TRADE PROBLEMS

(Continued from page 482)

London on September 22nd. Mr. Percy Brooks, of Harrods, Ltd., presided. Matters discussed included the following :—Co-operative advertising; Safeguarding of Industries (Pottery and Glassware); Merchandise Marks (Imported Goods) Bill, 1926; and the recent advance in prices of Staffordshire goods. Arising out of the discussions on safeguarding of industries and merchandise marks a proposal was made by Mr. C. E. White, of Belfast (R. Hogg & Co., Ltd.), that the Council should recommend all members of the retail trade to discriminate publicly in their display of British and foreign goods in such a way as to make clear to their customers wherever possible the origin of the goods offered to them. The opinion was expressed that the sales of British goods would be materially increased if the public were in a position to know what they were buying.

Apropos of this, the new Merchandise Marks Bill finished its Standing Committee Stage in the House of Commons at the end of July. As a result of more than 100 amendments which were made by the Committee, the Bill is now half as long again as it was when it received its Second Reading in May. It now has to go back to the floor of the House of Commons for debate on Report Stage and Third Reading. It is understood that the Government intends to treat the measure as one of its first-class Bills to be carried to the Statute Book this year. It may therefore become law in December.

THE LONDON LEAD OXIDE Co., Ltd.

Offices : 107, Bishopsgate, LONDON, E.C.2
Telephone No. : London Wall 4527.
Tele. Address : "Londoxid, Ave, London."

Works : Royal Pier Rd., GRAVESEND, Kent.
Telephone No. : Gravesend 112.

MANUFACTURERS OF

GENUINE **ENGLISH** REFINED

GLASSMAKERS'
RED LEAD

Buyers who wish to obtain the very best material at the lowest price should write for samples and particulars.

BRAND
ALOSIL

SILLIMANITE BRICKS
FOR GLASS WORKS
SILICA BRICKS & REFRACTORY GOODS
PICKFORD, HOLLAND & Co. Ld.
SHEFFIELD.

Vitreous Enamel Colours.
Stains for Glass.
Oxides for Colouring Glass Metal.
Selenium Metal.
Selenate and Selenite of Soda.

GROUND BONE, FELSPAR, FLINT, FLUORSPAR, QUARTZ, STONE, WHITING, ETC.,

CARBONATE & SULPHATE of BARYTES

OXIDES OF ANTIMONY, ARSENIC, CHROME, COBALT, SMALTS, COPPER, IRON, MANGANESE, NICKEL, TIN, TITANIUM, URANIUM, ZINC, ETC.

TRADE MARK

WENGERS, LTD.
CERAMIC COLOURS & CHEMICALS
ETRURIA.
STOKE-ON-TRENT.
England.

Samples & Price Lists Sent on Demand

COLOURS FOR POTTERS, GLAZED BRICK MANUFACTURERS, & GLASSMAKERS.

PREPARED ENAMELS FOR CAST & SHEET IRON, COPPER & JEWELLERY.

Limespar.
Phosphate of Lime.
Nitrate of Soda.
Nitrate of Potash.
Opavetro for Opacifying Glass.
Alumina, Oxide and Hydrate.

SILLIMANITE

The High Temperature Resisting Refractory Material.

(*Softening Point above 1800°C.*).

Supplied ground from – 10 mesh to – 100 mesh. For all bricks, blocks, flue linings, siege coverings, and glasshouse pots and rings.

For the convenience of users who desire to have sillimanite ready prepared with binder, the following mixtures are also supplied dry or ready for use:—

Slip, Pot and Ring Mixtures.
(PROF. W. E. S. TURNER'S Formulæ).

Tank Block, Brick & Pot Mixtures.
(MR. W. J. REES' Formulæ).

Siege Mixture.
(GLASS RESEARCH ASSOCIATION'S Formula).
For lining the floor siege of pot furnaces and general purposes, patching, etc.

The P.B. SILLIMANITE
COMPANY, LIMITED,
Sole Agents : PAWLE AND BRELICK.
791, SALISBURY HOUSE,
LONDON WALL, LONDON, E.C.2.

Telephone Number - London Wall 4825.
Telegrams - - PLATOONS, LONDON.

August Trade Returns.

IMPORTS OF GLASS AND GLASSWARE.

		Quantities.				Value.			
		Month ended 31st August.		Eight months ended 31st August.		Month ended 31st August.		Eight months ended 31st August.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)...	value	—	—	—	—	5,388	6,408	40,434	44,568
Glass Tubing and Rod for all purposes... ...	cwts.	695	746	4,215	4,409	756	2,473	13,456	14.791
Illuminating Glassware	,,	12,870	17,588	94,386	100,500	36,706	50,074	251,694	289,455
Machinery Glassware	,,	11	6	147	94	49	74	1,474	687
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	49,501	51,032	370,088	398 773	134,124	147,277	1,011,154	1,095,558
Plate and Sheet Glass	,,	86,908	114,010	729,730	874,187	127,001	133,237	1,080,693	1,155,208
Optical Glass (other than worked Elements, e.g. Lenses)	,,	—	2	41	15	16	349	3,320	1,860
Bottles and Jars	gross	169,191	128,532	837,338	963,515	66,101	78,009	523,230	585,569
Glass and Glassware not elsewhere specified ...	cwts.	1,254	3,350	15,125	22,051	5,452	7,337	47,311	56,986
Total Value	£	—	—	—	—	375,593	425,238	2,972,766	3,244,682

EXPORTS OF GLASS AND GLASSWARE (BRITISH PRODUCTS).

		Quantities.				Value.			
		Month ended 31st August.		Eight months ended 31st August		Month ended 31st August.		Eight months ended 31st August.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)...	value	—	—	—	—	6,909	5,840	45,844	46,571
Tubing and Rod for all purposes	cwts.	268	285	2,287	3,164	1,557	1,696	15,599	18,828
Illuminating Glassware	,,	514	640	4,140	4,051	4,356	5,426	38,207	35,466
Machinery Glassware	,,	297	274	2,919	1,746	1,944	1,972	20,460	13,441
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	2,898	3,173	22,068	20,134	31,419	34,526	202,528	200,252
Plate and Sheet	,,	59,871	59 380	544,774	595,776	106,870	118,328	1,048,843	1,083,783
Optical (other than worked Elements, e.g. Lenses)	,,	3	19	72	54	140	714	1,800	1.629
Bottles and Jars	gross	31,341	26,649	221,901	197,023	28,247	22,743	218,979	187,387
Manufactures, not elsewhere specified	cwts.	524	769	5,004	5,886	3,395	5,517	28,892	36,098
Total Value	£	—	—	—	—	184,857	196,726	1,621,152	1,623,455

EXPORTS OF GLASS AND GLASSWARE (FOREIGN AND COLONIAL MERCHANDISE).

		Quantities.				Value.			
		Month ended 31st August.		Eight months ended 31st August.		Month ended 31st August.		Eight months ended 31st August.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)...	value	—	—	—	—	451	718	4,216	3,827
Glass Tubing and Rod for all purposes ...	cwts.	1	—	11	8	15	1	156	111
Illuminating Glassware	,,	190	213	1,119	1,334	1,270	1,464	8,553	10,703
Machinery Glassware	,,	—	—	1	4	—	—	26	100
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	868	758	5,845	5,673	5,953	6,406	37,424	38,550
Plate and Sheet	,,	105	361	1,903	3,802	141	438	2,783	3,857
Optical Glass (other than worked Elements, e.g. Lenses)	,,	—	5	33	30	—	53	280	316
Bottles and Jars	gross	2,010	3,584	16,625	13,941	2,007	2,901	14,784	12,005
Glass and Glassware not elsewhere specified ...	cwts.	49	38	528	369	279	380	3,079	2 222
Total Value	£	—	—	—	—	10,116	12,361	71,301	71,691

Autumn Trade Problems.

(By OUR CITY CORRESPONDENT.)

At the time of writing the issue of the coal dispute is still in doubt, but high hopes are entertained that some accommodation will be reached enabling work to be resumed in the mines during October. The leeway to make up will, of course, be immense, and in the desperate effort to recover coal export markets the price of coal for home industrial purposes may stand at a very inconveniently high figure during the winter months. There will, however, be the satisfaction of seeing factories once more in full swing which have been entirely crippled for some time past.

The trade depression accentuated by the coal strike has led some glass manufacturers to renew their public demand for a safeguarding tariff. In September a good deal of attention was attracted in the trade by the public advertisements of Messrs. Ackroyd & Best reiterating the grievance felt by the glass industry at the treatment it has received from the Board of Trade. They point out that 41 trades have applied to the Government for the help promised by Mr. Baldwin in his election speech, but that six only have got anything. They state that, apart from the coal strike, there are vastly more unemployed in Great Britain than there are in any country in the world. It is understood that at the Conservative Congress which is to be held at Scarborough at the beginning of October a resolution will be moved by Brig.-Gen. Sir Henry Page-Croft urging the dissatisfaction of the rank and file of the Conservative Party over the safeguarding activities of the Government and demanding that the machinery shall be "gingered up." Special complaint is made of the great difficulty encountered by British manufacturers in compiling the statistics, etc., which seem to be necessary in order to satisfy the Board of Trade that there is a prima facie case for a public enquiry. It will be claimed that the conditions set out in the White Paper of February, 1925, should be considerably relaxed. Many manufacturers consider that it is wrong that an industry desiring protection from unfair foreign competition "should have to supply whole masses of figures concerning the activities of foreign competing firms, etc., which are only obtained at great expense and trouble." It is suggested that the Board of Trade itself should be able to collate all the relevant facts and give much more assistance to the manufacturers in preparing their cases than at present it seems disposed to give.

There is undoubtedly some substance in these complaints. On the other hand there is a tendency to under-rate the difficulties under which the opponents of a duty also labour in respect of these enquiries. At very short notice indeed they have to meet a tribunal on the basis of memoranda containing alleged facts and many figures which have been compiled by the applicants over a period of months, and which can only be properly dealt with on a basis of formal rébutting evidence where such exists. This often involves the preparation of certified documents as to labour conditions, cost of production, etc., in competing countries, a by no means easy task.

The fact is that those who want a duty and those who do not are equally dissatisfied with the safeguarding procedure. It seems, however, unlikely that any material change will be made during the life-time of the present Parliament.

Meanwhile the Board of Trade is steadily continuing its policy and has appointed a Committee to examine the tariff claims of two further industries, viz., the Light Leather Goods manufacturers and the Birmingham metal fittings industry. The Committee in these matters will commence its public hearing of evidence on October 13th.

I understand that some of the importers of glassware were inconvenienced in September by a sudden rise in the shipping freights between Hamburg and London. The charges on flint glass were suddenly increased from 11s. 6d. to 22s. 6d. This increase, coming in the middle of the busy season of importation for Christmas trade, was naturally unpalatable, and involved some hardships where contract arrangements were involved, especially for cheap and bulky goods; but apparently the shipping companies have a very good answer to the importers. They point out that the rates ruling up to the 1st September were extraordinarily low and had resulted in heavy losses of money by the shipowners. Moreover, the figure now charged is merely a reversion to the freight levels of 1924. What is more remarkable, the present level of rates is actually that which was ruling in 1914, in spite of the fact that the present normal expenses of the shipping companies must exceed those of 1914 by over 100 per cent. (wages, cost of discharging and loading, harbour dues, etc., etc.). The present abnormal price of bunker coal has, of course, made matters much worse for the shipowners, quite apart from the normal increase of charges to which I have referred. Moreover, the level of the new rates from Hamburg to London is not in excess but in fact is below that ruling to other ports to and from Hamburg for similar trades. What will probably happen is that a certain proportion of traffic which has been coming from Hamburg will now revert to its natural routes and the Hamburg route will become less congested.

A leading authority in the glass trade who has just returned from a prolonged visit to the Continent tells me that he has found the position of the glass trade generally bad. The fall in the exchange rates of France, Belgium and Italy has greatly reduced for the time being the purchasing power of these countries. In Germany home trade is still very bad and the effects of the previous currency troubles still seem to be felt. In Czecho-Slovakia (speaking generally) the glass works are only working half time.

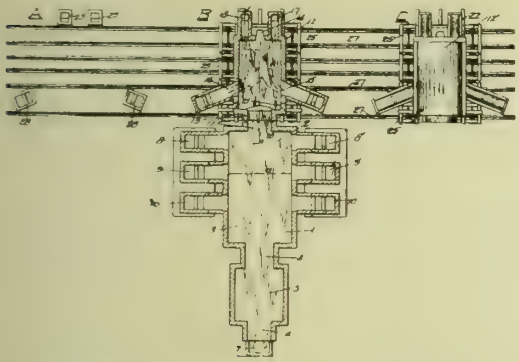
The Executive Council of the China and Glass Retailers' Association held its autumn meeting in

(*Continued on page* 479.

United States Patents.

GRANTED AUGUST 17th, 1926.

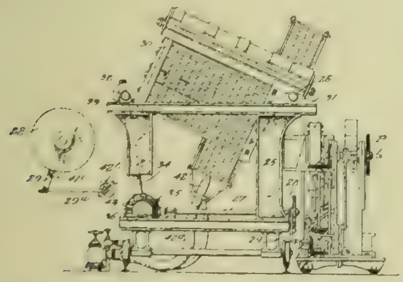
1 596,058.—**Glass-melting Furnace.** Leopold Mambourg, Lancaster, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed February 7, 1923. Serial No. 617,432. 11 Claims. (Cl. 49—56.)



3. The method which consists in introducing molten glass into a refining tank, melting raw materials in a tank disconnected from the refining tank and subsequently uniting said tanks and causing a union of the glass in the two tanks into a single pool.

4. In a continuous tank furnace, a melting tank, a refining tank, and a neck or conduit connecting the two tanks, the melting tank being bodily movable away from operating connection with the refining tank.

1,596,124.—**Glass-feeding Mechanism.** Theodore C. Steimer, deceased, late of Pittsburgh, Pa., by Charles M. Steimer, executor, Zanesville, Ohio, assignor, by mesne assignments, to The Hartford Special Machinery Company, a Corporation of Connecticut. Original application filed February 12, 1910, Serial No. 543,582. Divided and this application filed October 27, 1925. Serial No. 65,188. 4 Claims. (Cl. 49—55.)



1. In an apparatus for delivering glass ; the combination with a melting furnace pivoted to move on a horizontal axis, a heated chamber adjacent to the furnace and having a delivery orifice, and co-ordinated means to permit the intermittent flow of glass from the orifice and to tilt the furnace to deliver glass to the heated chamber at a rate equal to the rate of escape from the orifice to maintain a constant glass level in the chamber.

1,596,395.—**Process of Making Fused Multi-focal Lenses.** Lucian W. Bugbee, Jr., Indianapolis, Ind., assignor, by mesne assignments, to Continental Optical Corporation, New York, N.Y., a Corporation of Delaware. Filed December 8, 1925. Serial No. 74,206. 3 Claims. (Cl. 49—82.1.)

1. In the process of making fused multifocal lenses wherein there is a major element with a countersink and a minor element to be fused therein, superimposing the major element upon and covering the minor element by engaging the minor element before fusion only at one margin thereof, and then fusing them, whereby as the major element sags during the fusion the air between the two elements will be expelled before ultimate fusion of the two elements.

1,596,396.—**Process of Making Fused Multi-focal Lenses.** Lucian W. Bugbee, Jr., Indianapolis, Ind., assignor, by mesne assignments, to Continental Optical Corporation, New York, N.Y., a Corporation of Delaware. Filed December 14, 1925. Serial No. 75,356. 5 Claims. (Cl. 49—82.1.)

1. In the process of making fused multifocal lenses, wherein there is a major element with a countersink and a minor element to be fused therein, superimposing the major element upon and covering the minor element and then fusing them, whereby the major element will during the fusing sag down and bring the surface of the countersink into fusing relation with the surface of the minor element.

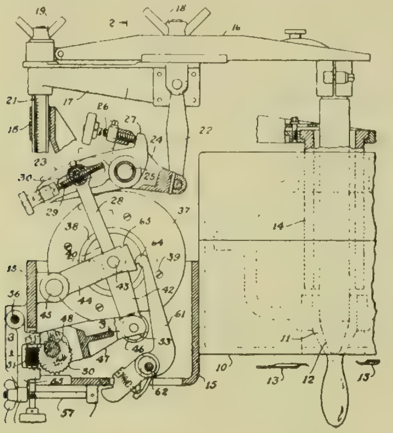
1,596,397.—**Process for Making Fused Multi-focal Lenses.** Lucian W. Bugbee, Jr., Indianapolis, Ind., assignor, by mesne assignments, to Continental Optical Corporation, New York, N.Y., a Corporation of Delaware. Filed December 14, 1925. Serial No. 75,357. 2 Claims. (Cl. 49—82.1.)

1. In the process of making fused multifocal lenses wherein there is a major element with a countersink and a minor element to be fused therein, placing the minor element on a block having a curvature approximately that of the curvature of the major element and with the curvature of the minor element extending upward, superimposing the major element on said minor element with a countersink resting substantially on the centre of the minor element, mechanically holding said major element on the minor element and block so that the major element will not engage the block preliminary to fusion, and thereafter fusing said elements, whereby the major element will, during the fusing, sag down on the minor element and the block.

1,596,604.—**Apparatus for Surfacing Glass and the Like.** Albert E. Evans, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed June 5, 1923. Serial No. 643,501. 4 Claims. (Cl. 51—110.)

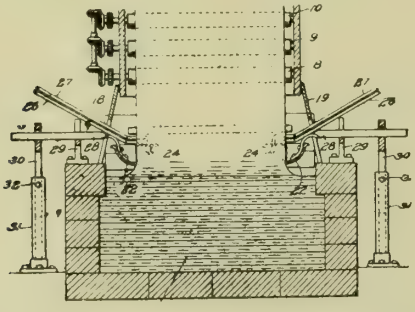
1. In combination in a surfacing machine, a framework, a surfacing unit mounted and guided for vertical movement with respect to the framework and comprising a support provided with bearings, a vertical runner shaft journaled therein, and a runner secured to the lower end of the shaft, driving means mounted independent of said unit to one side thereof, counterbalancing means connected to the support, and driving connections between the driving means and said runner shaft, the said unit being releasably supported upon the framework so that it may be removed bodily therefrom.

1,596,438.—**Glass-feeding Apparatus.** Edward H. Lorenz, West Hartford, Conn., assignor to Hartford Empire Company, Hartford, Conn., a Corporation of Delaware. Filed November 18, 1925. Serial No. 69,756. 21 Claims. (Cl. 19—55.)



1. Apparatus for feeding molten glass, comprising a container for the molten glass having a discharge outlet, a reciprocating implement for regulating the discharge of glass through the outlet, a cam and a cam roll for reciprocating the implement and means for adjusting the cam roll circumferentially with respect to said cam, whereby the time of operation of the implement may be changed.

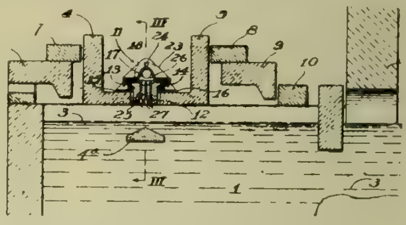
1,596,654.—**Apparatus for Making Sheet Glass.** Joseph S. Gregorius, Mount Vernon, Ohio, assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed January 13, 1926. Serial No. 80,943. 3 Claims. (Cl. 49—17.)



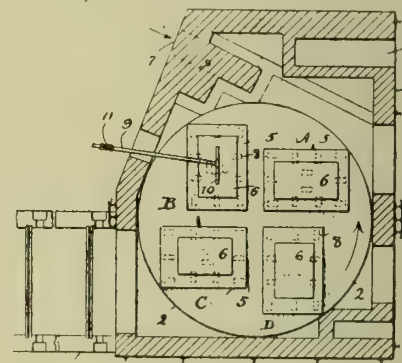
1. In combination with apparatus arranged to draw a glass sheet from an open pool of molten glass, of means for preventing inward movement of the edge of the sheet in said pool comprising a shielding plate spaced above the surface of the pool but closely adjacent thereto and having a slot extending inward from its edge and fitting around the edge of the sheet, a cooling member mounted on the plate along each side of the slot, and means for circulating a cooling liquid through said members.

1,596,666.—**Glass Tank Construction.** Karl G. Kutchka, Wilkinsburg, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed December 10, 1925. Serial No. 74,556. 7 Claims. (Cl. 49—53.)

1. The combination with a glass tank, of a refractory top member in opposition to the surface of the glass provided with a plurality of passages leading downward through said member, and means for supplying a mixture of gas and air through said passages.



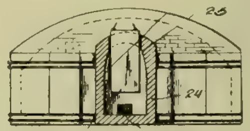
1,596,749.—**Method and Apparatus for Flattening Glass.** Samuel A. McKittrick, Sandusky, Ohio. Filed October 10, 1925. Serial No. 61,685. 5 Claims. (Cl. 49—44.)



1. The method of flattening curved shawls of glass which comprises placing a shawl upon a flattening stone in a portion of a flattening furnace where the heat is sufficient to cause the glass to soften and flatten out on the stone, shifting said stone with the flattened glass sheet thereon to a point where the temperature is lower, and applying a cooling medium to the top surface of said sheet.

GRANTED AUGUST 24th, 1926.

1,597,073.—**Glass Furnace.** James T. Keenan, Parkersburg, W. Va. Filed July 7, 1924. Serial No. 724,628. 4 Claims. (Cl. 49—55.)



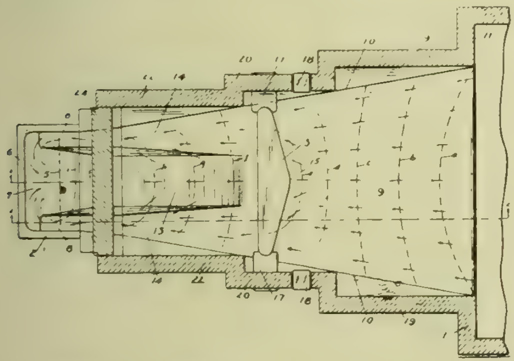
2. In an apparatus of the class described, the combination of a main furnace comprising a glass melting tank and a refining tank, an auxiliary feed tank in communication therewith having a discharge opening above the glass level therein, a displacer, means to reciprocate said displacer in said auxiliary tank to thereby displace the molten glass therein and cause it to discharge through said discharge outlet, the walls of said auxiliary tank being sloped inwardly above the normal level of the molten glass thereby to effect an accelerated displacement of the glass upon reciprocation of said displacer.

1,597,439.—**Apparatus for Feeding Glass Parts.** John T. Fagan and Francis J. Rippl, Cleveland, Ohio, assignors to General Electric Company, a

Corporation of New York. Original application filed September 19, 1922. Serial No. 589,249. Divided, and this application filed January 19, 1925. Serial No. 3,220. 8 Claims. (Cl. 49—2.)

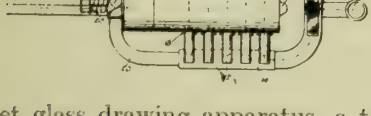
1. In a feeding apparatus, the combination of an inclined chute having a slot therein adapted to support a series of tubes in substantially vertical positions and to allow them to feed therealong by gravity, a holder at the lower end of said chute adapted to receive said tubes and to allow them to be removed one by one in a substantially vertical position and means for preventing crowding during said removal comprising a means for retracting the tube abutting against the tube in said holder and subsequently allowing said retracted tube to enter the holder.

1,597,440.—**Continuous Tank Furnace.** Enoch T. Ferngren, Toledo, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed March 2, 1923. Serial No. 622,270. 29 Claims. (Cl. 49—54.)



1. A continuous tank furnace for supplying molten glass to sheet-glass machines, comprising a melting tank, a relatively small and shallow pot from which the sheet is drawn, and a refining and cooling tank connecting the melting tank and pot, the side walls of the refining tank converging progressively from the relatively large delivery opening in the melting tank to the relatively narrow open end of the pot.

1,597,481.—**Means for Heating an Annealing Lehr and Process of Annealing.** Guy J. Rice, Charleston, W. Va., assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed November 3, 1924. Serial No. 747,583. 15 Claims. (Cl. 49—3.)

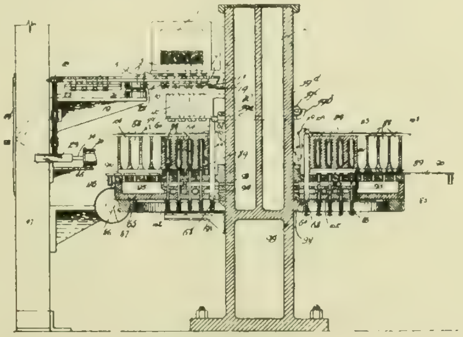


1. In sheet glass drawing apparatus, a tank furnace means for drawing a sheet, an annealing lehr, and means for heating the annealing lehr comprising means for absorbing heat from the exhaust gases from said furnace, means to pass air in proximity to the heat absorbing means to heat the same, and means to pass the thus treated air through the annealing lehr.

1,597,543.—**Glass-Drawing Apparatus.** George G. Roberts, Washington, D. C., assignor to Virginia Plate Glass Corporation, Washington, D. C., a Corporation of Virginia. Filed August 2, 1923. Serial No. 655,286. 1 Claim. (Cl. 49—17.)

A glass-drawing crucible of substantially elliptical form in horizontal section having its end-walls undercut, i.e., inclined outwardly toward the ends of the crucible, said end-walls each being provided with a central vertical groove, for the purpose set forth.

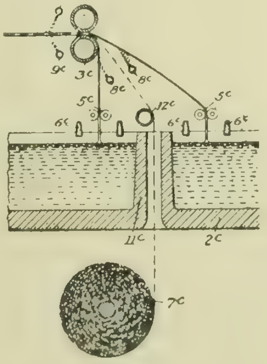
1,597,612.—**Glass-Blowing Machine.** Walter Devlin Morrison, Newport, near Melbourne, Victoria, Australia. Filed October 11, 1921, Serial No. 507,118, and in Australia November 1, 1920. 5 Claims. (Cl. 49—5.)



1. In glass blowing machines, the combination therewith of at least one pattern and finishing mould arranged radially, and in sets upon a rotating table, an intermittently operated rotatable feed table provided with a number of receiving pockets radially disposed in sets, each set corresponding in number to each set of pattern moulds on the mould table, a feed tank, a plurality of feeding orifices from the tank, an automatically operating sliding bar positioned below the feeding orifices and fitted to the feeding table, and receiving cups disposed in a radial casing below the sliding bar, the cups delivering globules into the receiving orifices of the pattern moulds.

GRANTED AUGUST 31st, 1926.

1,597,953.—**Manufacture of Sheet and Wire Glass.** Clarence P. Byrnes, Sewickley, Pa. Filed June 19, 1920. Serial No. 390,116. Renewed June 27, 1925. 25 Claims. (Cl. 49—32.)



12. In the manufacture of sheet glass, the steps consisting of drawing a sheet vertically from a glass bath, engaging it by opposed rolling surfaces while travelling

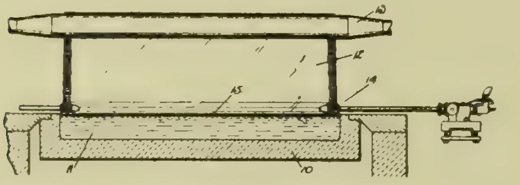
vertically, and then deflecting it into a path at an angle to both the vertical and the horizontal.

1,597,994.—**Method and Apparatus for Annealing and Cooling Sheet Glass.** William L. Monro, Pittsburgh, Pa., assignor to Window Glass Machine Company, Pittsburgh, Pa., a Corporation of New Jersey. Filed February 12, 1924. Serial No. 692,249. 8 Claims. (Cl. 49—47.)

1. In the method of annealing and cooling sheet glass, the steps consisting of passing flat hot glass through a lehr tunnel in one direction, and causing gaseous fluid initially cooler than the glass to travel through substantially the entire length of the tunnel in the opposite direction, and in contact with the glass, substantially as described.

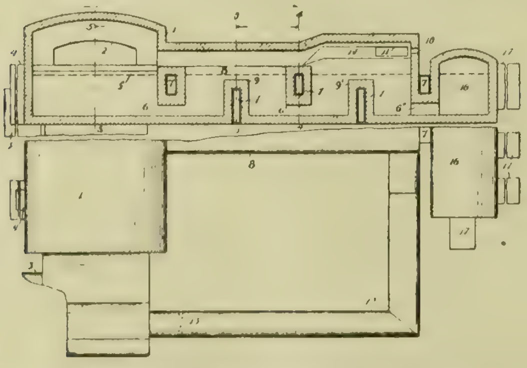
6. Apparatus for annealing and cooling sheet glass, including a lehr tunnel, means for passing glass therethrough in one direction, and means for causing gaseous fluid to travel through the tunnel in the other direction in streams on each side of the glass, substantially as described.

1,598,073.—**Sheet-Glass-Drawing Apparatus.** Enoch T. Ferngren, Toledo, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed October 11, 1924. Serial No. 742,995. 21 Claims. (Cl. 49—17.)



1. In the art of drawing sheet glass, the method of producing a flat sheet consisting in drawing the sheet from a surface cooled supply of molten glass without restraint except adjacent the border portions of the sheet where the drawn portion of the supplying glass is tapered off laterally to the desired edge thickness while being mechanically restrained from advancement in the line of draw.

1,598,307.—**Apparatus for Melting and Fining Glass.** Robert D. Pike, San Francisco, Calif., assignor to Cole-French Company, a Corporation. Filed October 25, 1922. Serial No. 596,731. 4 Claims. (Cl. 49—53.)



1. An apparatus for melting and fining glass comprising an open-hearth regenerative furnace whose dimension longitudinally of the flame is greater than its dimension transverse thereto, a submerged port leading from said furnace, a fining compartment connected with said submerged port to continuously receive melted glass from the furnace, means in said fining compartment for mixing the constituents of the melted glass and removing therefrom the gaseous products of decomposition and a working chamber into which the glass is continuously delivered from said fining compartment.

1,598,308.—**Method of and Apparatus for Fining Glass.** Robert D. Pike, San Francisco, Calif., assignor to Cole-French Company, a Corporation. Filed November 1, 1922. Serial No. 598,265. 5 Claims. (Cl. 49—53.)

1. A method of fining glass, which consists in passing the melted glass through a vacuum chamber and applying heat to said chamber to maintain the temperature of the glass.

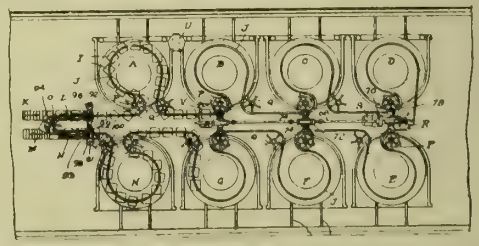
3. The combination with a glass tank furnace, of a vacuum chamber connected therewith and through which the glass is passed for the purpose of fining, and electrical heating means to maintain the temperature of the glass while passing through said chamber.

GRANTED SEPTEMBER 7th, 1926.

1,598,651.—**Glass-working Machine.** James S. Moore, Grafton, W. Va. Filed March 15, 1921. Serial No. 452,411. 2 Claims. (Cl. 49—9.)

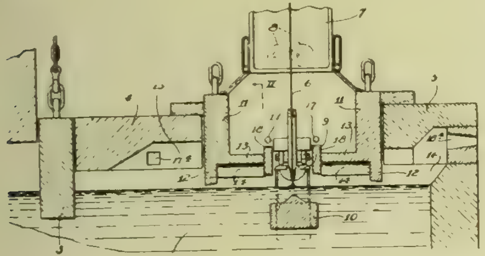
2. In a glass working machine having a table for blowmoulds, an air supply which includes means actuated by fluid pressure for intermittently moving the table and other means for locking the table between its intermittent movements, a casing, a control valve in the casing, said valve comprising end heads and a central head carried within a casing of greater length than the distance between the end heads, said casing having a longitudinal way provided with end ports and a central port, means between the end and central ports for reducing the area of a portion of the said longitudinal way, exit openings adapted to be alternately closed by the extreme ends of the control valve, and ports which are placed alternately in communication with pipes through which fluid pressure is supplied to actuate the table moving and the table locking means.

1,598,720.—**Apparatus for Surfacing Sheets or Plates.** Halbert K. Hitchcock, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed June 1, 1922. Serial No. 565,053. 15 Claims. (Cl. 51—110.)



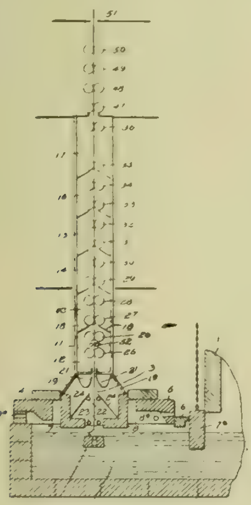
1. The combination with a circular driven surfacing table, of means for supporting thereabove a series of sheets of material to be surfaced, and carrier means for giving such means a movement of translation to the table, then circumferentially thereof and finally away from the table.

1,598,729.—Apparatus for Making Sheet Glass. Walter G. Koupal, and Joseph S. Gregorius, Mount Vernon, Ohio, assignors to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed January 13, 1926. Serial No. 80,947. 4 Claims. (Cl. 49—17.)



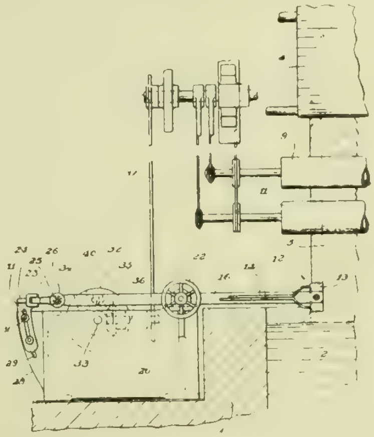
1. The combination with a glass tank, having a refractory top spaced above the glass, with a drawing opening therethrough, and sheet drawing means for drawing a sheet upward from the bath with its line of generation lying transversely of the tank, of a refractory block extending transversely of the tank on each side of the drawing opening and having its lower edge extending down below said top to a level adjacent the surface of the glass bath in the tank, the said bottom edge of each block being bowed down so that it is closer to the bath at the central portion thereof than at the edges.

1,598,730.—Process and Apparatus for Making Sheet Glass. Walter G. Koupal, Mount Vernon, Ohio, assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed August 12, 1925. Serial No. 49,743. 5 Claims. (Cl. 49—17.)



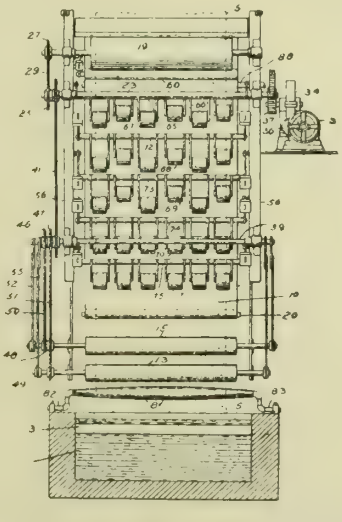
1. Apparatus for drawing sheet glass from a molten bath, comprising a vertical casing mounted above the bath and provided with a series of transverse partitions dividing the casing into a plurality of compartments, pairs of driven rollers mounted in the casing for carrying the glass sheet upward therethrough, and a pair of heating members on opposite sides of the glass sheet and extending transversely thereacross, and located at a level in the casing where the temperature of the glass before heating by said members lies in the critical annealing range.

1,598,740.—Edge-holding Device for Sheet-Glass Machines. Leon Mondron, Salem, W. Va., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed February 16, 1924. Serial No. 693,275. 7 Claims. (Cl. 49—17.)



1. In combination with apparatus for drawing a glass sheet from a molten bath, means for preventing inward movement of the edge of the sheet, comprising a pair of engaging members on opposite sides of the sheet closely adjacent the point of formation thereof where the glass edge is plastic, and means for causing the members to intermittently engage such edge and thin it while maintaining said members against any substantial movement away from the centre line of the sheet.

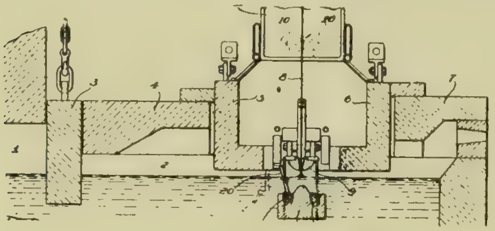
1,598,751.—Apparatus for Drawing Sheet Glass. Harry G. Slingluff, Mount Vernon, Ohio, assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed February 26, 1923. Serial No. 621,184. 12 Claims. (Cl. 49—17.)



10. In glass drawing apparatus for drawing a sheet or ribbon continuously from a bath of molten glass, a pair of vertical opposing endless insulating curtains spaced above the bath adapted to receive the sheet and

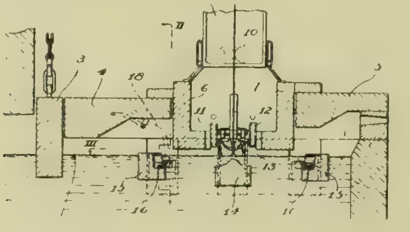
contact with it while the glass is dropping in temperature from that below the setting point to a point at which the glass may be cracked off, and opposing driven rollers between the curtains and the glass for applying drawing force to the sheet.

1,598,764.—**Apparatus for Making Sheet Glass.** John H. Fox and Harry F. Hitner, Pittsburgh, Pa., assignors to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed January 13, 1926. Serial No. 80,938. 6 Claims. (Cl. 49—17.)



1. The combination with a glass drawing tank, of a draw-bar of refractory material extending transversely of the tank submerged below the surface of the glass and provided on its upper side with a longitudinal groove, a molten metal lying in said groove, and means for causing a flow of electric current through said molten metal to heat the glass lying above the draw-bar.

1,598,765.—**Process and Apparatus for Drawing Sheet Glass.** John H. Fox and Harry F. Hitner, Pittsburgh, Pa., assignors to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed January 13, 1926. Serial No. 80,939. 16 Claims. (Cl. 49—17.)

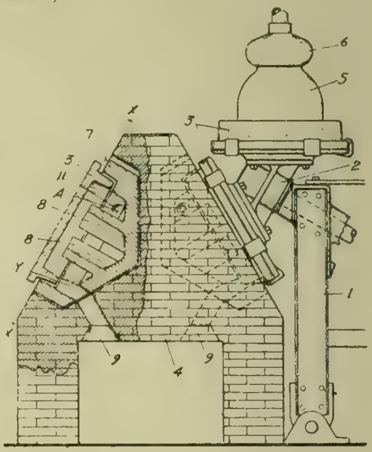


1. A process of drawing glass, which consists in drawing a sheet upwardly from a molten bath, and passing a flow of electric current through the bath so that the major portion thereof flows through the layer of glass at the surface of the bath from which the sheet is drawn.

1,598,766.—**Apparatus for Holding Plates or Sheets upon Surfacing Tables.** John H. Fox, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed June 10, 1925. Serial No. 36,130. 7 Claims. (Cl. 51—235.)

1. The combination with a surfacing car or table mounted for movement along a track and having a glass supporting surface, an exhausting chamber having communication with such surface provided with an outlet having a check valve, a vacuum terminal or intake member mounted adjacent the path of movement of the table and adapted to register with said outlet as the table moves past it, means for applying suction to said member, a valve for said member, and means for opening said valve when said member is brought into registration with said outlet.

1,598,782.—**Furnace for Heating Glass-drawing Pots.** Frederick A. Ost, Coffeyville, Kans. Filed November 15, 1924. Serial No. 750,137. 10 Claims. (Cl. 49—53.)

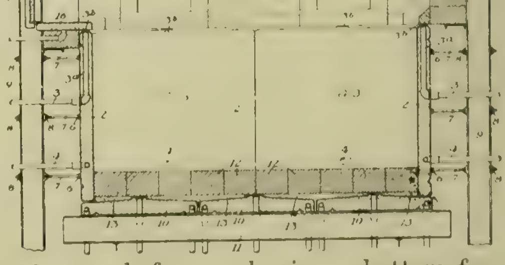


1. In a furnace of the character described, a removable combustion-chamber having its closed end cone-shaped, baffles in said combustion chamber, burners entering the sides of said combustion-chamber for admitting a combustible fuel against said baffles, whereby the burning fuel is given a circular motion.

1,598,789.—**Gate for Glass Tanks.** John E. Sweet, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed January 13, 1926. Serial No. 80,970. 4 Claims. (Cl. 49—55.)

1. The combination with a melting tank having an outlet opening at its forward end, of a water cooled metal gate member to the rear of such outlet opening having an opening therethrough and mounted for vertical movement, and a movable water cooled section closing said opening and mounted for vertical movement in said gate member.

1,598,779.—**Glass Furnace.** Charles D. McArthur, Pittsburgh, Pa., assignor to BlawKnox Company, Blawnox, Pa., a Corporation of New Jersey. Original application filed November 1, 1919. Serial No. 334,996. Divided and this application filed March 11, 1921. Serial No. 451,486. 10 Claims. (Cl. 122—6.)



1. A glass tank furnace having a bottom formed of

refractory blocks seated upon a series of hollow water-cooled members, said members being independent of each other and separately removable, substantially as described.

1,599,182.—**Glass-working Machine.** James S. Moore, Grafton, W. Va. Filed March 15, 1921. Serial No. 452,410. 2 Claims. (Cl. 49—9.)

1. A parison transfer for glass working machines comprising an arm provided at one end with a downwardly extending portion, a pair of parison engaging jaws which are pivotally attached to said downwardly extending portion of the arm, a member attached to the arm to extend upwardly and over said downwardly extending portion of the arm, a cylinder attached to said member, a piston having a piston rod connected with the jaws, a casing for a control valve attached to the arm, means depending from the casing for unseating valves to control the movement of the piston connected with the jaws, and oscillatory frame which engages the arm, and pneumatically controlled means for raising and lowering the arm.

BRITISH PATENTS.

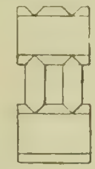
The following abstracts are taken from the Illustrated Official Journal of Patents with the special permission of the Controller of H.M. Stationery Office.

Printed copies of the full specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C., price 1/- each.

254,330.—**Glass Manufacture.** Glas-fabrik Akt-Ges. and Stein, G., Brockwitz, near Dresden, Germany. June 25, 1926, No. 16053. Convention date, June 25, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. Drawings to Specification. (Class 56.)

Materials for moulds.—Moulds or tools for working glass, particularly cast iron moulds in which a pattern has been cut, are hardened by "coating their working-surfaces with a layer of chrome."

254,505.—**Furnaces.** Breisig, A., 46, Erdbrustgasse, Vienna. June 25, 1925, No. 16384. (Classes 51 (i) and 87 (i).)

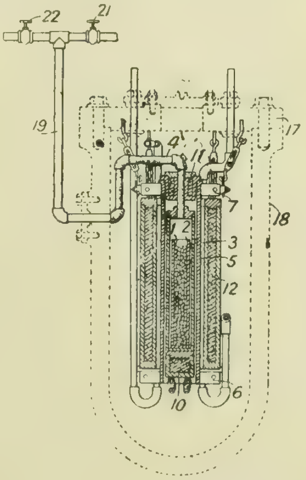


Regenerators, bricks, special shapes of.—In brickwork for regenerators, bricks of rectangular section are ridged at their upper and lower ends, the upper ridge being formed with notches, extending to the same depth as the ridge, to facilitate building up. Specification 4366/07 is referred to.

254,580.—**Glass Manufacture.** Feeny, V. F., 73a, Queen Victoria Street, London.—(Illinois Pacific Glass Co.; 15th Street, San Francisco, U.S.A.). October 30th, 1925, No. 27306. Drawings to Specification. (Class 56.)

Annealing.—A process for annealing glass articles in a temperature-controlled lehr comprises the steps of preliminary annealing for a short time at a relatively high temperature, rapidly reducing the temperature to a point still within the annealing range for a further annealing, and then continuously cooling. In a typical example of the process, as applied to the treatment of heavy five-gallon bottles, on entering the lehr the temperature is rapidly raised to 930° F. and maintained for 12 minutes. The temperature is then lowered, as rapidly as possible, to 875° F. and maintained for a further 12 minutes. The rate of cooling after this second annealing stage is then progressively increased.

255,118.—**Electric Furnaces; Fusing Silica.** British Thomson-Houston Co., Ltd., Crown House, Aldwych, London.—(Assignees of Devers, P. K.; 6. Pierce Road, Lynn, Massachusetts, U.S.A.) July 13, 1926, No. 17528. Convention date, July 13, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Classes 39 (iii) and 56.)



Silica is fused in a container by radiant heat, means being provided to prevent access of vapours from the heater to the silica and access of silica vapours to the heater. Quartz crystals 1 are charged into a crucible 2 surrounded by a closed receptacle 3 connected by a graphite tube 4 and metal tube 19 to a vacuum system 22 and a pressure system 21. The crucible and receptacle are made of graphite, tungsten or molybdenum. The receptacle is surrounded by a graphite heater 5 surrounded in turn by a graphite screen 12. The screen and heater are suspended from the cover 17 of a gas-tight tank 18. The heater is supplied with current by water-cooled copper terminals 6, 7. The receptacle 3 rests on a graphite cup 10 and is shielded at the top by a graphite member 11. The tank 18 may be omitted if the walls of the graphite receptacle and the tube 4 are sufficiently thick.

255,281.—**Furnaces; Gas-producers, etc.** Johnson, J. Y., 47, Lincoln's Inn Fields, London.—(Badische Anilin & Soda Fabrik; Ludwigshafen-on-Rhine, Germany.) October 10, 1925, No. 25321. (Classes 51 (i) and 51 (ii).)

Air supply, heating.—The blast for furnaces, producers, etc., is heated by burning tar in the blast prior to its entrance into the furnace. The blast supply pipe for the producer is provided with a combustion chamber, into which tar is fed, atomised by a nozzle and burnt, thus heating the air which, together with the products of combustion of the tar, passes into the producer through nozzles.

255,893.—**Glass Manufacture.** Dehandschutter, R., 90, Chaussee a Manage, Belgium. July 23, 1926, No. 18379. Convention date, July 23, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)

FIG 1

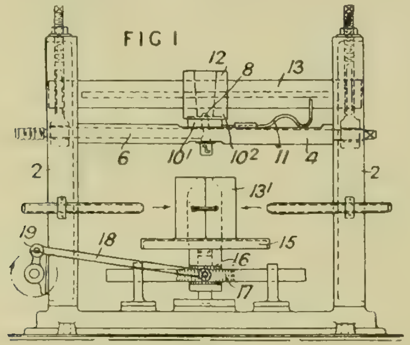
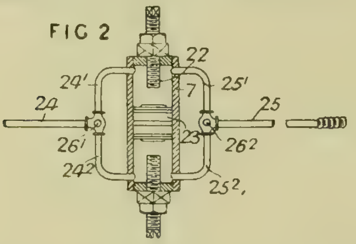


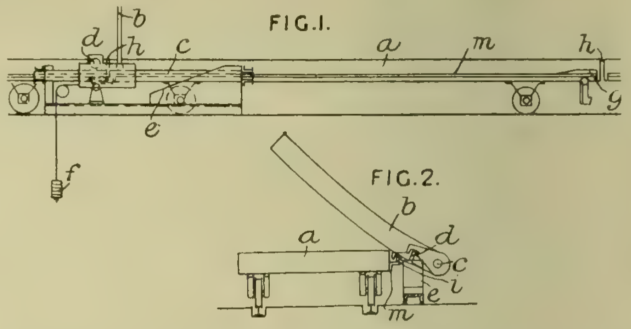
FIG 2



Blowing.—A machine for blowing tableware has means for oscillating the finishing mould about its longitudinal axis in order that the ware may be free from seams or mould marks. A device for supplying a constant volume of air for blowing each article is also provided. The machine comprises a horizontal shaft 4, Fig. 1, journaled in uprights 2, one half of the shaft having an axial boring 6 to enable air to be supplied to a blowing-nipple 8. A ring mould is fitted on the shaft, one half, 10^1, of the mould being fixed, while the other half, 10^2, is movable by means of a bolt 11. A two part parison mould 12 is hinged to a crosspiece 13. The finishing mould 13^1 is in two parts and is mounted on a plate 15 which can be oscillated about its axis by a crank 19, connecting rod 18, rack 17, and pinion 16. In use, after the parison is formed, the mould 12 is opened and the shaft 4 is turned over to bring the parison into the finishing mould. When the mould is closed, the crank 19 is rotated so that the mould is oscillating while the article is being blown.

Air supply for blowing.—The device for supplying air consists of a piston 23, Fig. 2, which moves in a cylinder 7 between adjustable stops 22. A compressed air pipe 24 is connected with the ends of the cylinder by way of a two-way cock 26^1 and branch pipes 24^1 and 24^2. Another pipe, 25, which is connected with the passage 6 in the shaft 4, is also connected with the ends of the cylinder through a two-way cock 26^2 and branch pipe 25^1, 25^2. The two cocks are linked to one another, so that when compressed air is admitted to one end of the cylinder, the movement of the piston forces a definite volume of air, at a lower pressure, through the pipe 25 into the parison which is being blown.

255,899.—**Glass Manufacture.** Reis, L. Von, 25, Merksteinerstrasse, Herzogenrath, Germany. July 26, 1926, No. 18616. Convention date, July 27, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)



Rolling.—Relates to a method of cutting hot, plastic sheet glass while it is resting on a travelling carrier, and consists in cutting the sheet above transverse gaps in the carrier by a blade which moves with the carrier and enters a gap when severing the glass. The sheet, formed by suitable rolling-apparatus, is received on tables a, Fig. 1, which run on rails and convey the sheet to the lehr. Successive tables are separated by gaps h into which a knife blade b drops when cutting through the sheet. The blade b swings about, and is free to slide along a shaft c which is mounted parallel with and to one side the track on which the tables a are mounted. The tables have rails m, Fig. 2, fixed to one edge, and a roller i carried by the blade b rests on these rails and holds the blade in its raised position. A coupling is also provided to keep the blade raised when the tables are out of position. In operation the tables receive the glass sheet from the rolling-machine and pass below the blade b towards the right of Fig. 1. When the roller i falls through the gap between successive rails, the blade drops into the gap between the tables and cuts through the glass sheet. A stop g on the rail m carries the blade along with the table until a roller d, carried by the blade, runs along a fixed cam e and raises the blade out of the gap. A counterweight f then draws the blade back along the shaft c to its initial position.

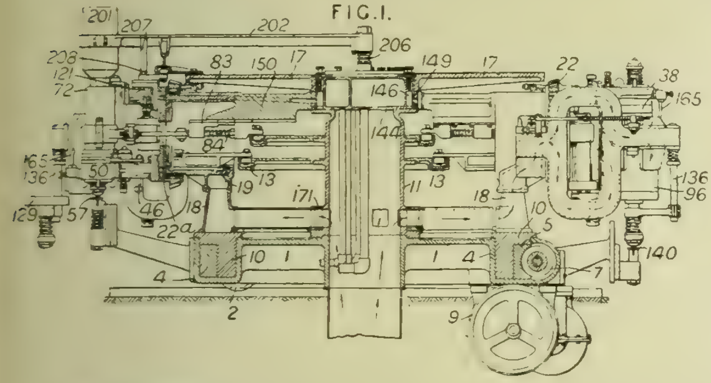
255,927.—**Glass Manufacture.** Pearson, T. F., 66, Henson Grove, Airedale, Castleford, Yorkshire. April 27, 1925, No. 10869. (Class 56.)

Blowing.—A continuously rotating blowing machine of the turnover type, intended for use in conjunction with an automatic feeder, comprises a rotary ring carrying a number of mould units each of which supports blow mould arms and a turnover member arranged between the arms, each turnover member carrying parison mould arms and a blowhead. Air for blowing the ware and for cooling the moulds is supplied from a central distributor through passages formed in the body of the mould units.

General construction. The machine comprises a circular bedplate 1, Fig. 1, mounted on wheels 2, a central vertical hollow column 11 secured to the bedplate, and a ring 10 which rotates in a circular groove or track 4 in the bedplate and supports the mould units. Cams

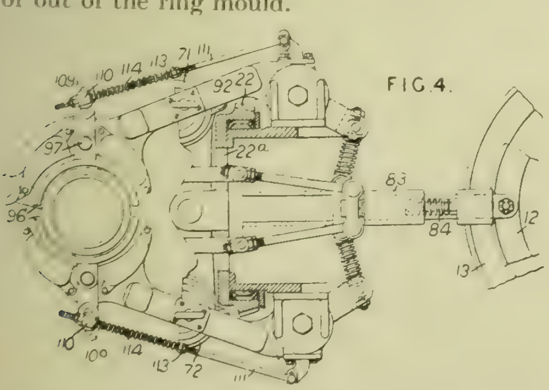
12, 13 and a spider 17 are secured to the column 11. Each mould unit is mounted on a hollow base 18, bolted to the ring 10, and comprises a hollow cylindrical body 19 on one end of which a turnover plate 22a is rotatably mounted. A bevel gear 22, formed on the rim of the plate, engages segmental racks mounted on the spider 17 and thus turns over the ring and parison moulds which are carried by the plate 22a.

FIG. 1.



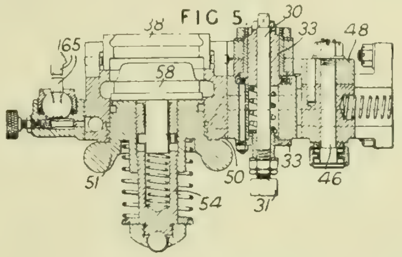
Ring moulds. The halves 38 of the ring mould are pivoted on a bush 33 carried by a pin 30, Fig. 5, which is provided with a handle 31. A turn of the handle enables the bush on which the ring mould is mounted to be quickly removed and replaced. The mould halves are connected to a slide 48, and a pin 46 projecting from this slide comes into contact with a cam secured to the spider 17 and opens and closes the mould. The bracket that supports the ring mould carries a blowhead 50 which contains the mouth-forming plug 58. A tailpiece 54 projecting from the blowhead makes contact, as the moulds turn over, with a spring-cushioned cam 57, Fig. 1, and raises the plug 58 into the ring mould. The plug bearing is formed in a wing nut 51, Fig. 5, which screws into blowhead and is quickly removed when replacement of the plug is necessary. The plug may be arranged to make bottles with screw mouths, its bearing being screw threaded so that the plug when revolved is fed into or out of the ring mould.

FIG. 4.



Parison and finishing moulds. Each parison mould is made in two halves 71, 72, Fig. 4, which are pivoted on the plate 22a and are opened and closed by a slide 83 mounted within the cylindrical body 19 and operated by a fixed cam 12. A spring 84 is interposed between the slides and the cam roller to prevent damage if the mould halves should be obstructed. The finishing mould halves 96 are carried by arms 92, which are pivoted on the cylindrical body 19 and are moved by a cam 13 to open or close the mould. The mould halves are pivoted at 97 to the arms 92 and have slotted extensions 109. Radius rods 111, pivoted at one end to the brackets of the arms 92, slide through swivel stops 110 which are adjustably secured to the extensions 109, springs 114 being interposed between the stops 110 and nuts 113 screwed on to the rods. By this construction, the mould halves are made to swing about their pivots 97 and their meeting faces remain approximately parallel with one another as they are moved apart, and are prevented from damaging the finished article. The mould arms 92 are rectangular in outline, as shown in Fig. 1, and enclose a space into which the halves of the parison mould enter when they are folded back, and the finishing mould closes. A bottom 129 for each finishing mould is carried on a spindle 136 pivoted on one of the arms 92. The bottom is swung below the mould by a cam and is raised into position by a cam 140. According to the Provisional Specification, the bottom block may be arranged to form bottles with "pushed" bottoms.

FIG. 5.



Air supply; cooling. Compressed air and suction is distributed to the blowheads by a stationary chamber 144 and a port ring 149 rotatably mounted thereon and connected by radial arms 150 to the cylindrical bodies 19. The ports through the walls of the chamber 144 are opened or closed by valves 146 which can be adjusted to control the quantity of air delivered to a blowhead at any particular period in its cycle of operations. An air jet 165 is mounted on each blowhead to direct air on to a blank while it is suspended from the ring mould previous to transfer to the blow mould. The object of this is to cool the blank to overcome the tendency to curl. The arms 92 of the finishing moulds are hollow, and air is supplied to these hollow arms by means of a ring 171 rotatably mounted on the column 11 and connected with its interior by ports. The air issues from ports in the arms and is blown on to the moulds to cool them.

Driving-mechanism. The machine is driven by means of a motor 9 through a worm wheel 7 and worm ring 5 coaxial with the ring 10. A clutch connecting the two rings enables the machine to be stopped instantly but ensures that when the clutch is re-engaged, the machine will be in step with the feeder.

Gathering. A gathering-funnel 201 is carried by a swinging arm 202 which has a lug 207 that engages a lug 208 on the machine frame. The funnel is thus forced to move with the machine, but when a charge has been received from the feeder, the funnel arm is disengaged from the lug 208 and a spring 206 swings the funnel back into position to direct a charge into the following mould.

Removing formed articles. The finished articles left hanging from the ring moulds may be deposited on a rotating table which delivers them to a moving conveyer.

Latest British Patents.

Applications.

21013—August 26, 1926. S. George. Closures for bottles etc.

20974—August 25, 1926. J. Cox. Manufacture of reinforced glass.

21015—August 26, 1926. E. A. Hailwood. Lamp shades, globes, etc.

21051—August 26, 1926. C. Atkins. Looking glasses, etc.

21094—August 27, 1926. W. V. Lambert. C. Macnair. Furnace for glass etc.

21229—August 29, 1926. H. Kessler, W. Kessler. Glass preserving vessels.

21253—August 28, 1926. (United States September 5, 1925.) L. J. Broche. Machine for making and finishing glass bars, etc.

21471—August 31, 1926. Rankin Automatic Glass Feeder Co., Ltd. C. H. Rankin. Charging molten glass into moulds.

21474—August 31, 1926. T. C. Moorshead. Glass shaping machines.

21535—September 1, 1926. F. Siegheim. Manufacture of double walled glass flasks.

21671—September 2, 1926. F. E. V. Beanes. Bottles etc., and stoppers therefor.

21831—September 4, 1926. J. J. H. Sturmey. Bottle for automatic cooling of contents.

21952—September 6, 1926. R. H. Carpmael. Closures for bottles, etc.

22201—September 9, 1926. B. F. Clark. Simon-Carves, Ltd. Insulation of furnaces.

22230—September 9, 1926. S. B. Marshall. Bottles, etc., for advertising.

22256—September 9, 1926. Rasselsteiner Eisenwerks Ges. Akt. Ges. Generating supplementary steam for gas-producers.

22262—September 9, 1926. M. Simpson. Non-refillable bottles, etc.

22585—September 14, 1926. H. C. Dann. Bottle for poisons, etc.

Specifications Accepted.

245111—December 19, 1924. A. Sandberg. Recuperative heat-exchange apparatus for air or other media.

245120—December 19, 1924. P. A. Favre. Machine for making articles from glass tubing.

245449—December 29, 1925. (Convention date not granted.) E. Wessely, N. Starrach and F. Schmied. Apparatus and processes for drawing glass.

248310—February 24, 1925. A. W. Cash Co. Pressure-controlled regulating devices, particularly adapted for regulating combustion in furnaces.

253494—June 11, 1925. M. Bicheroux. Methods and devices for manufacturing plate glass.

257067—July 16, 1925. Z. Hadnagy and V. G. de Christian. Decoration of electric incandescent lamps and bulbs.

257073—July 20, 1925. W. A. Coles. Device for opening milk bottles and the like.

257167—February 5, 1926. Dairy Supply Co., Ltd. C. C. F. Smith. Boxes or cases for the reception and transportation of bottles.

257536—March 3, 1926. Soc. Anon. d'Etudes et de Construction d'Appareils Mecaniques pour le Verrerie. Process of gathering glass by suction.

257637—March 7, 1925. P. C. Rushen (Hartford Empire Co). Machinery for manufacturing glass-ware.

257641—April 6, 1925. A. McNish and Automatic Bottle Machine Corporation, Ltd. Machines for making bottles or other articles of glass.

258008—June 11, 1925. H. Bartlett. System of puttyless glazing.

258087—February 6, 1926. W. Hancock. Glazing bars.

258093—September 28, 1925. E. C. R. Marks (Erie Glass Co). Manufacture of sheet glass.

258127—November 23, 1925. W. J. Mellersh-Jackson. (Hartford Empire Co.) Manufacture of blown glassware.

Open to Public Inspection.

257590—August 27, 1925. Manufactures des Glaces et Produits Chimiques de St. Gobain, Chauny & Cirey. Process of stretching glass.

257892—September 5, 1925. Soc. Anon. des Ateliers de Construction et Fonderies de Jeumont (Anciens Etablissements T. Haut). Water-cooled spreading rollers or rolling machine for the manufacture of plate glass and glass sheets of all kinds.

257926—September 5, 1925. L. J. Broche. Machine for making and finishing glass bars, rods, tubes, bottle necks, and the like.

258228—September 14, 1925. Tucker, Reeves & Beatty. Method of and apparatus for delivering measured quantities of glass.

Patents, Trade Marks, Inventions.—Advice, Handbook and Consultations free. King's Patent Agency, Ltd., Director B. T. King, C.I.M.E.; Regd. Patent Agent, G.B., U.S., and Canada, 146a, Queen Victoria Street, E.C.4, and 6, Quality Court (near Patent Office), London, W.C. 39 years' references. 'Phone: Cent. 682.

The Proprietor of British Patents Nos. 190224, 190225, 193080 and 193365, all dated September 12, 1921, relating to "Improvements in and relating to Mechanism for Removing and Conveying Articles from Glass Blowing Machines," "Improvements in Take-out and Steadying Mechanism for Glass Blowing Machines," "Improvements in Machines for Blowing Glass," and "Improvements in Transfer Mechanism for Glass Blowing Machines" is desirous of entering into arrangements by way of a licence or otherwise on reasonable terms for the purpose of exploiting the above patents and ensuring their practical working in Great Britain. All inquiries to be addressed to B. Singer, Steger Building, Chicago, Illinois.

Patents and Designs Acts, 1907 and 1919. The Proprietors of British Patents Nos. 140029 and 205766 are prepared to sell the patents or to licence British manufacturers to work thereunder. They relate to apparatus for drawing glass cylinders. No. 140029 comprises automatic means for increasing the venting during drawing and No. 205766 comprises a partially enclosed air chamber located immediately at the back of the bait for regulating air pressure. Address B. W. & T., 112, Hatton Garden, London, E.C.1.

"Improvements in Glass-gathering Mechanism." The Owners of British Patent No. 112613 desire to dispose of the same or would enter into working arrangements with a firm likely to be interested. Particulars may be obtained from TECHNICAL RECORDS, LTD., of 59-60, Lincoln's Inn Fields, London, W.C.2.

"Improvements in Vacuum-jacketed Vessels." The Owners of British Patent No. 190434 desire to dispose of the same, or would grant a licence to work the invention on royalty terms. Particulars may be obtained from TECHNICAL RECORDS, LIMITED, of 59-60, Lincoln's Inn Fields, London, W.C.2.

Glass Works for Sale, Stourbridge District, containing modern 9-pot Frisby Feeder Furnace, Lehrs, Pot-arch, Warehouses, Office, Showroom, etc. Freehold property. Owner would consider flotation of company.—Box 313, Glass Publications, Ltd., Talbot House, Arundel Street, London, W.C.2.

Glass and Scientific Apparatus Manufacturer desires post as buyer to first-class firm or would consider agency for foreign house. Give full particulars in confidence.—Box 314, Glass Publications, Ltd., Talbot House, Arundel Street, London, W.C.2.

GLASS

THE RECOGNIZED ORGAN OF THE GLASS INDUSTRY
Published on the Tenth of Each Month.

Single Copies - - - - One Shilling
Annual Subscription - - 10/6 post free

GLASS PUBLICATIONS Ltd.
TECHNICAL PUBLISHERS,
Talbot House,
Arundel Street,
Telephone: Central 5985. **Strand, London, W.C.2.**

CONTENTS.

PAGE
Editorial Notes 495
Refractories for the Glass Industry (*continued*). By W. J. Rees, B.Sc., Tech., F.I.C. (Lecturer in Refractories, University of Sheffield) 496
Simplified Practice Applied to Refractories. By Prof. W. Trinks 498
The Use of Compressed Air (*continued*). By Robert Wilson 499
The Society of Glass Technology 503
The Decomposition of Glass. Some Minute Formations. By James Scott, M.S.C.I., M.A.C.S., M.E.H.A. .. 507
Belgian Glass Industry 511
Some Observations of Surface Deposits formed in Glass Furnace Regenerators. By Herbert Insley 513
Trade Notes 515
Pottery and Glass at the Fair 517
The Pottery and Glass Trades Benevolent Institution .. 517
An Oil Burning Installation for Use in the Glass Industry .. 518
Federation of British Industries Trade Report and Forecast 523
The Economic Manifesto and Surgical Trade 525
September Trade Returns 527
United States Patents 528
British Patents 532
Latest British Patents 535
Correspondence 536

Editorial Notes.

Within the last few days there have been indications that there is a possibility of the coal dispute, now in its seventh month, being brought to a close. This move, however, cannot be attributed to any ability or intelligence on the part of the leaders, but rather to the action of the men themselves forcing the issue. Approximately one-third of the miners employed have returned to work in defiance of their leaders and the Miners' Federation orders, and the recent decision of the Federation to open negotiations is nothing more or less than an attempt to save their face, as if things were allowed to continue it is obvious that the National Federation would become unnecessary.

Unfortunately, there has been intervention by outsiders who, however well-intentioned their efforts, have only succeeded in prolonging the controversy because they have created the impression amongst the men that if only they showed sufficient determination their demands would eventually be granted.

The unrest in other industries as well as this dispute can be attributed to ignorance on the part of the rank and file with respect to certain elementary economic facts. Of course, this has possibly been aggravated by the actions of leaders with political aspirations, who, no doubt, have misrepresented the position, but this would not have been possible if the ignorance just mentioned had not existed and the men had realised the basis on which industry rests.

In a measure also the troubles are a legacy of the War period, when costs were of no account and demands for wage increases, etc., were freely granted on the basis that the "Government pays." If only the men would realise that "the Government" has no money except that obtained from industry, which in turn, of course, is themselves, many of the difficulties would be obivated.

Even when the coal dispute is over it must not be supposed for a moment that the whole trouble is ended. Industrial peace will never be established until it is generally recognised that the standard of living is not something that can be maintained or increased by human volition or by Act of Parliament, but only by maintaining the wealth production of the whole community.

It must be self-evident that the average standard of living in any country or community is simply equal to the total wealth production divided by the number of its inhabitants.

Without in any way advocating the doctrines of socialism, it is obvious that what is required is a more equitable distribution of the rewards of industry, and to endeavour to obtain this should be the task of all parties in the State. There should no longer be a discrepancy between the wages earned by a sheltered worker, i.e., one in an industry not open to external competition, as for example railways, and those of an unsheltered worker, that is, a man employed in an industry the products of which must compete with those of other countries both as regards price and quality if the industry is to flourish. To encourage any class to attempt to extract from the community as a whole, higher remuneration than its services are worth, is equivalent to condemning another class, equally deserving it may be, to accept less than its fair share.

Taking these two principles, therefore, the first thing to do is to make every one realise that it is only by increased effort that the total wealth of the country and therefore the standard of living can be increased. Secondly, once the wealth is available for this increase, the next step necessary is to provide for its better and more equitable distribution.

[Glass *will deal with all matters pertaining to the industry in an impartial manner, consequently the Editor does not necessarily associate himself with the opinions expressed by his contributors.*]

Refractories for the Glass Industry.

By W. J. REES, B.Sc., Tech., F.I.C. (Lecturer in Refractories, University of Sheffield).

(*Continued.*)

Silica Cements.

It is desirable to emphasise the importance of giving adequate attention to the quality of the cement used for the jointing of silica bricks. Silica brick structures may fail through the use of a cement of insufficient refractoriness. Silica cements of the following general types are in industrial use :—(a) A mixture of crushed ganister or other quartzite and plastic fireclay ; (b) a mixture of crushed ganister or other quartzite and lime ; (c) a mixture of a fine-grained high-silica sand and plastic fireclay ; (d) crushed silica bricks (" bats " or selected and cleaned unfluxed used bricks), alone or mixed with plastic fireclay.

So far as the physical characteristics of the cement are concerned, it should be sufficiently fine to develop the necessary plasticity. It is not necessary or desirable that it should consist of a uniform very fine grain, as this tends to a reduction in refractoriness and to excessive drying shrinkage. The shrinkage should be small so that there will be no tendency for the cement to drop out of the joints during the " drying out " of the furnace or the early stages of heating. For glass furnace use the grain-size of the cement should be such that the whole of it passes through a 30-mesh I.M.M. sieve and 30 per cent. through a 200-mesh I.M.M. sieve.

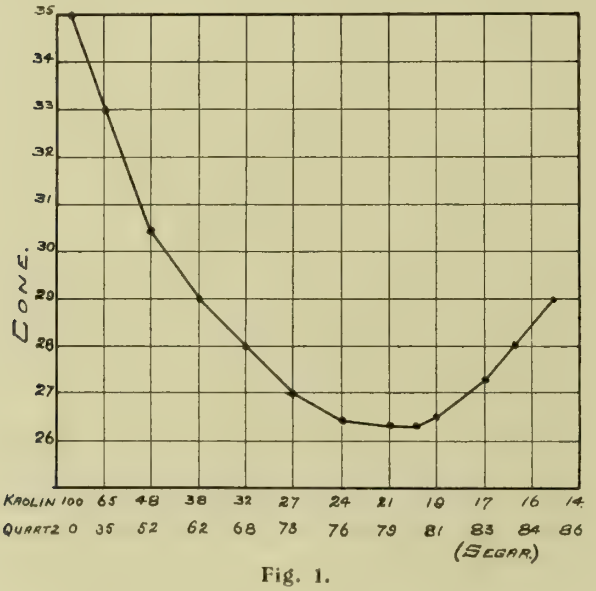


Fig. 1.

The proportion of plastic fireclay or lime used in the cement mixture should be such that its refractoriness is not lower than Cone 29. The curve in Fig. 1, due to Seger[1] shows the refractoriness of mixtures of finely ground pure silica and pure kaolin. The eutectic composition is approximately 4 parts of silica to 1 of kaloin, and its refractoriness is equivalent to that of Cone 27, but it must be remembered that the impurities normally associated with quartzites and plastic fireclays will depress the refractoriness of this 4 : 1 mixture by at least 1 cone. Bradshaw and Emery[2] in investigating the characteristics of silica and fireclay cements determined the normal refractoriness and refractoriness under load (load 35 lb. per sq. inch) of a series of mixtures of high-grade firebrick and silica brick ground so that the whole of the silica and 80 per cent. passed through a 200's lawn. The curves in Fig. 2 are drawn from their experimental results and it is desirable to emphasise the practical importance of them, as, in the walls and especially in the crowns of furnaces, the cement will be subjected to considerable mechanical pressure from the expansion of the bricks at high temperature. With coarser-grained mixtures the effect on the softening point was not quite so marked. The curves in Fig. 3

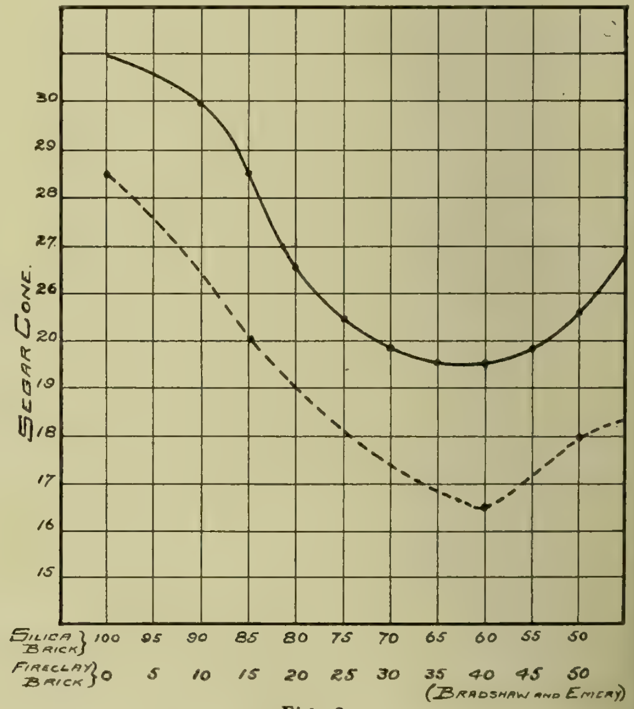


Fig. 2.

---

[1] Seger's collected works, p. 545.

[2] Trans. Ceramic Society, xxi, 107.

(Ricke[3]) show the effect of lime in admixture on the refractoriness of silica and mixtures of silica and fireclay, and indicate the importance of controlling the proportion of lime used in a quartzite-lime cement. Cements which are made from a mixture of crushed silica bricks and plastic fireclay will usually contain lime, as this is the bond generally used in silica brick making. It is undesirable that the fireclay proportion in such mixtures should exceed 6 or 7 per cent., and further lime should not be added. A useful test for determining the quality of a silica cement may be made by placing a thin layer of the cement between two bricks and heating them to a temperature 50°—100° C. higher than the maximum temperature likely to be reached by the bricks in use, but better is the underload test employed by Bradshaw and Emery. The Provisional Specification of the Society of Glass Technology[4] for Silica Cement suggests that the cement shall contain not less than 92 per cent. of silica.

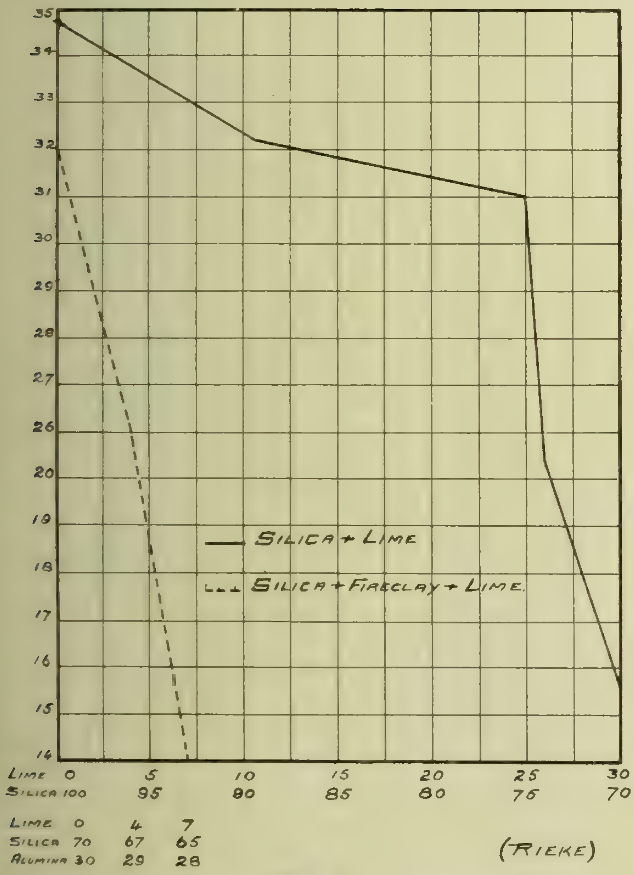


Fig. 3.

Testing.

The single test which gives most information as to the quality of a silica brick is the determination of its volume changes in a furnace designed for under-load tests. One furnace of this type was designed by K. Endell[5], and is illustrated in Fig 4. It consists of a vertical electric carbon resistance furnace with an inside diameter of about 4 inches, and a lever press. The furnace is designed to operate on a voltage of 100 to 120 and consumes about 12 kw. up to a temperature of 1600° C. The test-piece may be either a 2″ × 2″ cylinder cut out of the sample with a hollow diamond drill or a 2″ cube cut out of the brick. In referring, in the previous article (October, 1926, p. 453), to the mechanical behaviour of silica bricks under pressure at high temperatures, references were inadvertently omitted to the investigations made by Mellor and Moore[6], Mellor and Emery[7], Endell[8], Bodin[9], Hewitt Wilson[10], Koppers, Dale[12], Hartmann and Koehler[13], Howe[14], Rochow[15], Le Chatelier and Bogitch[16], Bigot[17], and Schurecht[18], which led up to the conclusions mentioned. For fuller details reference should be made to these papers.

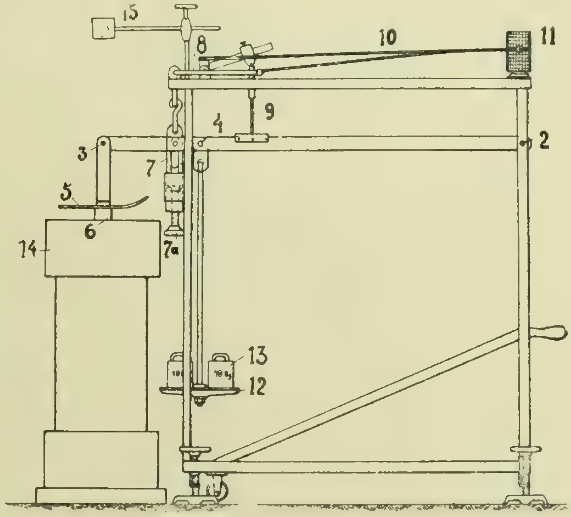


Fig. 4. (Scale 1 : 25.)

An exceedingly useful contribution to the study of the silica refractories, which should be in the library of the Glass Technologist, is the Memoir[19], on the petrography and chemistry of silica refractories by H. H. Thomas, A. F. Hallimond and E. G. Radley. Analyses are given of the various types of rock from which the refractories are manufactured, and their behaviour during the processes of manufacture, and their subsequent use is critically discussed. Excellent photo micrographs are shown illustrating both the original structure of the refractories and the structure developed after their use in high-temperature furnaces.

(To be continued.)

---

[3] Sprechsaal, 1907. Nos. 4, 44 and 45.

[4] Trans. Soc. Glass Tech., 1919, 3.

[5] The "Atom" Testing Machine, Trost Bros., 104, Victoria Street, London, S.W.1.

[6] Trans. Ceramic Soc., 15, 117.

[7] Trans. Ceramic Soc., 17, II, 360.

[8] Stahl u. Eisen, 41, 6-9.

[9] Ceramique, 23, 177-84. Trans. Ceram. Soc., 21, I, 56-65.

[10] J. Amer. Ceram. Soc.

[12] Trans. Ceram. Soc., 23, 217; 24, 170, 199.

[13] Trans. Amer. Electrochem. Soc., 37.

[14] Chem. and Met. Eng., 23, 1215-18.

[15] J. Ind. and Eng. Chem., 11, 1146-9.

[16] Trans. Ceram. Soc., 17, 1-6. Iron Tr. Rev., 1918, 1178. J. Soc. Chem. Ind., 38, 3.

[17] Trans. Ceram. Soc., 18, I, 165-81.

[18] J. Amer. Ceram. Soc., 2, 602-7.

[19] Memoirs, Geological Survey, 1920, 16.

SIMPLIFIED PRACTICE APPLIED TO REFRACTORIES.*

By PROF. W. TRINKS.

The fact that great strides have been made in standardizing practices in a vast number of industries where it at first seemed impossible to do so prompts a belief that it may likewise be possible insofar as refractories are concerned. This very " much to be desired goal," which would necessitate the closest of co-operation of all parties, if it could be effected, would undoubtedly mean a great saving to all concerned.

Strange as it may seem, present day conditions seem to call for an increase in the number of " standard shapes " rather than a reduction, but a reduction in the number of " special shapes," if practical, would materially assist as the first step towards simplified practice. Following that, a possible reduction of " standard shapes " might be in order.

It has been suggested that it is quite possible to reduce the number of standard shapes and to build up any other shapes that may be desired by a combination of standard shapes or by the cutting of the existing ones. There are, however, objections to this procedure, most important of which is the cost of labour for cutting and, since the object of introducing simplified practice is to reduce costs, it seems that the cost of cutting would more than offset any savings effected by a reduction of standard shapes. The cutting of bricks to shape not only means increase in labour costs, but also a loss of material.

An additional objection is the time required for cutting when that time is not available, as, for instance, during quick repairs which must be made while the furnace, if not in operation, is at least kept hot for quick starting.

While these reasons are very valid as objections to reducing the number of standard shapes they have been the very reasons responsible for the large number of special shapes already existing, and while there may not be an immediate possibility in the reduction of standard shapes there does seem a possibility of effecting savings in the matter of special shapes.

Many concerns order " special shapes " which are extremely similar and which, without much difficulty, could be displaced by a very much smaller number of either standard or semi-standard shapes.

Whenever several steel plants or glass plants are combined into one organisation one of the first considerations consists in making a comparison of refractory shapes used by the different plants of the new organisation. By discussion and a little yielding here and there a new shape is developed, which eliminates many of the former special shapes and becomes standard for all of the plants of the new organisation.

It should be possible to carry the same spirit still farther, and have all the steel plants get together, compare their " special " and " standard shapes " and, by a process of elimination, produce standard shapes which will take care of the former great variety of shapes. In the same way, all the coke plants and all the glass plants could get together, discuss their requirements and adopt standard shapes.

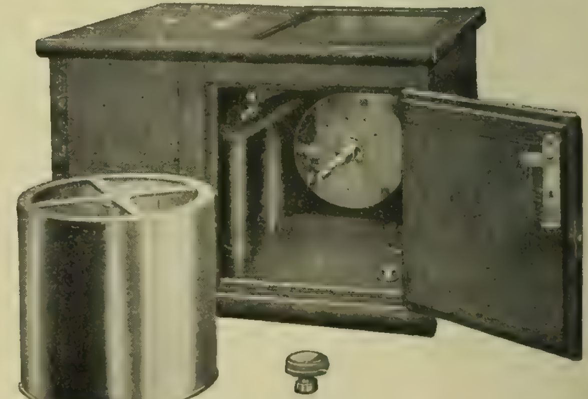
That the various societies have recognised the importance of standardisation is best evidenced by the work that is being done by the Joint Committee on Foundry Refractories (sponsored by the American Ceramic Society and the American Foundrymen's Association), which consists of representatives of many of the important technical societies and several government bureaus. However, the results of their efforts will depend largely on the co-operation extended to them by the users of these shapes. The initiative in this case lies with the users of the refractories.

If the various steel plants, glass plants, etc., would send their list of refractory shapes to secretaries of the various Technical Societies, and would furnish their whole-hearted support for investigating the extent to which changes from the now used special shapes should be made, a very large economic advantage could be had, that is, if the steps which are now being taken whenever several steel plants, coke plants, or glass plants consolidate could be taken for all similar plants throughout the United States.

---

* Fuels and Furnaces.

SIEMENS
TEMPERATURE RECORDER



Drum Recorder, Type M.V.R.G.

This Recorder gives a permanent record of temperature variations on a clockwork-driven drum, which rotates once in 24 hours. No batteries are required.

Further particulars and pamphlets on application.

SIEMENS BROTHERS & CO., LTD.,
WOOLWICH, S.E.18.
ESTABLISHED 1858.

The Use of Compressed Air—*Continued.*

The Determination of Pipe Diameters.

By ROBERT WILSON.

Compressed Air Piping.

The pipe range required to convey compressed air—from the air receiver to the apparatus wherein the power is utilised—does not, as a rule, give cause for much uncertainty, when viewed in a general way. No anxiety need exist as to the piping being of requisite strength for the air pressure, since, in this direction, the experience of reputable manufacturers can be relied upon. Neither is it a difficult matter to erect and adequately support the pipes, and should the need for draining facilities be thought of, provision can be made for drain cocks to be placed at various points in the system. There is no need, as in the case of a steam pipe range, to provide non-conducting covering against the annoyance and danger arising from the radiation of intense heat, nor to provide for an unusual amount of expansion and contraction; nor is it necessary to provide that safeguard common to a water pipe range, viz., the strength necessary to withstand the effects from inertia should the flow be interrupted.

On the whole the problem of a compressed air pipe range would appear, on first thoughts, to be easy of solution, and to resolve itself into the purchase and erection of pipes of the same diameter as that of the air discharge on the compressor, and with the means of joining one pipe to another. The absence of danger and discomfort from leakages of compressed air often causes this possibility to be disregarded and aids the supposition that a compressed air pipe line calls for no specialised consideration.

If, however, the compressed air pipe range is to be a good one, and is to possess the qualities which aid efficiency, some knowledge is essential of the provisions necessary to that end. These provisions mainly are as follow:—

(1) The pipes should be of sufficient diameter to reduce the loss of pressure due to friction to the lowest practicable, having regard to the total length of the pipe.
(2) The pipes should be of ample strength for the pressure.
(3) The range should be air-tight.
(4) The arrangement of the pipe range should provide for radiation and for the draining of the moisture which automatically separates from the air during cooling.
(5) A few bends should be arranged in the pipeline to take up the strains of expansion and contraction. Expansion joints are unnecessary.
(6) Sharp bends and elbows should be confined to branch pipes, and avoided in these if possible.
(7) Valves of the "straight through" or "sluice" type are useful for testing for leakages if placed throughout the system.
(8) All pipes should be placed above ground and positioned so as to be readily accessible for periodical examination.

The method of fixing the size of the air main the same as that of the air discharge on the compressor is a practice which rarely operates advantageously for any length of time, due to the fact that air installations nearly always grow. The use of compressed air—when once this convenient form of power has been placed "on tap"—has a tendency to increase beyond all anticipated requirements, with the result that the compressor plant has to be added to and, unless this possibility is recognised, the air mains may prove to be too small for the volume they will eventually have to convey. Therefore, one of the first considerations relative to fixing the size of the air main should be the probability of the plant being added to and of the main having to convey a larger volume than that delivered from the first installation.

This means, of course, installing a larger pipe than the size necessary for immediate requirements, and also a greater capital outlay, but, if there appears to be a likelihood of the plant being increased, the extra cost for the larger pipe will, in the end, prove an economy and a better way than that of installing a pipe large enough only for the plant being installed, and with which excessive transmission losses would occur when the plant is increased. The larger pipe adds to the storage capacity, and in this respect gives some return for the extra cost expended on it.

Frictional Loss in Transmission.

The losses in transmission due to frictional resistance consist of (1) a loss in pressure, and (2) a loss in power.

The loss in pressure varies directly as the square of the velocity, inversely as the diameter of the pipe, and can be said to be proportional to the length of the pipe.

Experiments have shown that when the velocity of flow in the main air pipe does not exceed 25 feet per second the loss of pressure is very small, and such as to be almost negligible.

The loss in power in transmitting compressed air is a smaller proportion of the total power than the loss in pressure is of the initial pressure, for the reason that with air the volume expands as the pressure falls, and as the energy stored in the air is due to its volume—in terms of the number of cubic feet of free air—as well as to its pressure, the expansion of volume largely compensates for the loss in pressure. Thus, while the pressure at the end of the pipe is likely to be lower than the pressure in the receiver, the volume occupied by the air at the lower pressure will be proportionately greater, so mitigating the loss in power.

For example, when the receiver pressure is 35 lb. gauge, and the gauge pressure at the end of the pipe range is 30 lb., the loss of pressure amounts to about 14 per cent., but the loss of stored energy in the air is only about 8½ per cent. as is shown below :—

Isothermal H.P. required to compress
1 cubic foot of free air to 35 lb. gauge pressure=0.0782
,, ,, 30 lb. ,, =0.0713

Difference in Power =0.0069

This difference, rated as a percentage

$$=\frac{.0069}{.0782}\times 100=8.7\%$$

It is, however, inadvisable to lay too much stress on the compensation derived from the expansion of volume consequent upon a reduction of pressure, since, in a properly proportioned pipe range, the reduction in pressure due to frictional resistance will be so very small as to almost eliminate any suggestion of the power being affected. The important consideration, therefore, is that the air main shall be of correct proportions for the volume and the distance through which the air has to be transmitted.

Size of the Air Main.

Before attempting to fix the size of the pipe it is necessary to ascertain the volume occupied by the compressed air, and in making the calculation for this it can be assumed that the temperature of the compressed air is the same as that of the free air. The air delivered from the compressor cools quickly when in contact with the receiver and pipe, and will not have travelled far in the pipe before assuming the temperature of the surrounding atmosphere. Therefore, the volume of the compressed air will be proportionate to the absolute pressure, so that if V_1 is the capacity of the compressor in cubic feet of free air per minute, P_2 the receiver pressure in lb. per sq. in. gauge, and V_2 the volume of compressed air flowing per minute in cubic feet, then

$$V_2=\frac{15\times V_1}{P_2+15}\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (25)$$

Having ascertained the volume of compressed air, and bearing in mind the limitation on velocity of flow, the size of pipe can be calculated from the formula which applies to the flow of all liquids, viz. :—

$$A=\frac{Q\times 144}{V\times 60}\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (26)$$

where A=the area of pipe in square inches.
Q=cubic feet of compressed air flowing per minute.
V=the velocity of flow in feet per second.

Example (1). What is the proper size for an air main to convey 600 cubic feet of free air per minute at an initial gauge pressure of 30 lb. per sq. inch ?

From equation (25) the volume of compressed air flowing per minute would be

$$\frac{15\times 600}{30+15}=200 \text{ cubic feet.}$$

Assuming a velocity of flow of 25 feet per second the minimum size of the air main should be

$$\text{Equation (26)}\quad A=\frac{200\times 144}{25\times 60}$$

=19.25 sq. inches or approximately 5″ diameter.

Loss of Pressure.

If it was desired to determine the probable loss of pressure due to frictional resistance in the pipe line, the formula most convenient for this purpose is that given in Unwin & Mellamby's "Elements of Machine Design —Part II," and which is as follows :—

$$h=f\frac{V^2}{2g}\ \frac{4l}{d}\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (27)$$

where V=velocity of air in feet per sec.
d=dia. of pipe in feet.
l=length of pipe in feet.
h=loss of head in feet.
g=the acceleration of gravity=32.2 feet per sec.
f=co-efficient of friction.

The value for the co-efficient of friction is given as

$$f=0.0027\left(1+\frac{3}{10d}\right)\ \ldots\ldots\ldots\ldots\ldots\ldots\ (28)$$

With the aid of these equations the loss of pressure can be calculated as under.

$$p=\frac{hW}{144}\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (29)$$

where p=loss of pressure in lbs. per sq. in.
W=weight of air at the initial pressure.

Taking the figures in example (1) and assuming the pipe range to be 1,000 feet long the co-efficient of friction for a 5″ dia. pipe would be—from equation (28)

$$f=0.0027\left\{1+\frac{3\times 12}{10\times 5}\right\}$$

$$=0.0027\times 1.72=.0046$$

and from equation (27)

$$h=\frac{0.0046\times(25)^2\times 4000\times 12}{64.4\times 5}$$

=425 feet head of air at 30 lb. gauge pressure.

Now the weight of 1 cubic feet of fee air at 60° F. is 0.0764 lb., and, as the weight of air varies directly as the absolute pressure if the temperature remains constant, the weight of 1 cubic foot of air at 60° F. and 30 lb. gauge pressure would be

$$0.0764\times\frac{45}{15}=0.2292 \text{ lb. per cubic foot.}$$

Therefore the probable loss of pressure during transmission through 1,000 feet of piping will be equation (29)

$$p=\frac{hW}{144}=\frac{425\times 0.2292}{144}=0.68 \text{ lb.}$$

and the terminal pressure will be

$$30-0.68=29.32 \text{ lb. gauge.}$$

The loss of pressure in properly proportioned pipes is, therefore, very small, but the pipe should be proportioned to the distance as well as to the volume of air, for, as stated above, the loss of pressure varies as the square of the velocity, and since the velocity gradually increases as the distance from the receiver grows—due to the expansion which takes place when the pressure is reduced—so the pressure loss will increase at a more rapid rate as the pipe becomes longer. A safe practice is to figure on a velocity of 20 feet per second—equal to 1,200 feet per minute—using equation (26) to determine the size of the pipe. For a velocity of 20 feet per second the size of the pipe in example (1) would be

$$A=\frac{Q\times 144}{V\times 60}$$

$$=\frac{200\times 144}{20\times 60}$$

$=24$ sq. ins. or approx. $5\frac{1}{2}''$ dia.

Table V.

Giving the values of V (d) for pipes up to 10″ diameter.

From these values can be ascertained the number of smaller diameter pipes which will be equal to the capacity of one pipe of larger diameter.

d (inches) ..	1	1½	2	2½	3	4	5	6	7	8	9	10
$\sqrt{(d)^5}$	1	2.75	5.65	9.88	15.6	32.0	55.9	88.2	129.6	181.0	243.0	316.2

Number of Branch Pipes.

The size of the connection on the apparatus using the compressed air fixes, as a rule, the size of the pipes branching off from the air main, and the method usually adopted for determining the number of branch pipes which can be used is that of dividing the area of the branch pipe into the area of the air main. For example, if the air main is 5″ diameter and the diameter of each branch pipe is 1″, then, *in proportion to the respective areas*, the number of branch pipes which can be used would be

$$\frac{\text{area of } 5''}{\text{area of } 1''}=\frac{19.75}{0.7854}=25$$

This method, however, is not correct. It is true that the areas of pipes vary directly as the square of their diameters—or of their cross-sectional areas—but the discharge capacity of piping is not proportional to the cross-sectional area only, and has been ascertained to vary somewhat as the *square root of the fifth power of the diameter.* That is, instead of the number of branch pipes being found from the equation $N=\frac{D^2}{d^2}$

where " D " is the diameter of main pipe
" d " the diameter of branch pipes
and " N " the number of branch pipes

the correct equation is

$$N=\frac{\sqrt{(D)^5}}{\sqrt{(d)^5}}$$

applying this to the example given above.

$$N=\frac{\sqrt{(5)^5}}{\sqrt{(1)^5}}=\frac{55.9}{1}=55.9$$

and, therefore, the number of 1″ diameter branch pipes which can be supplied from a 5″ diameter main pipe is 55 instead of 25.

The importance of utilising the correct method for determining the number of smaller diameter pipes which will be equal in capacity to a given pipe of larger diameter will be apparent, and Table V, giving values for $\sqrt{(d)^5}$, will be found useful when such procedure is necessary. The values for the smaller sizes when divided into the value for a larger size give the number of smaller pipes which will equal the capacity of the larger pipe. Thus, the number of 2 inch pipes which would be equal in capacity to one 5 inch pipe would be as follows :—

From Table V—5 inch pipe $=55.9$
2 inch pipe $=5.65$

then $$N=\frac{55.9}{5.65}=9.9$$

(To be continued.)

FOSTER
INDICATING PYROMETER
("Resilia" Patent)

An extremely accurate and sensitive instrument, incorporating the robust "Resilia" movement. 10″ scale, with red adjustable index.

Full particulars in Booklet 42 S.

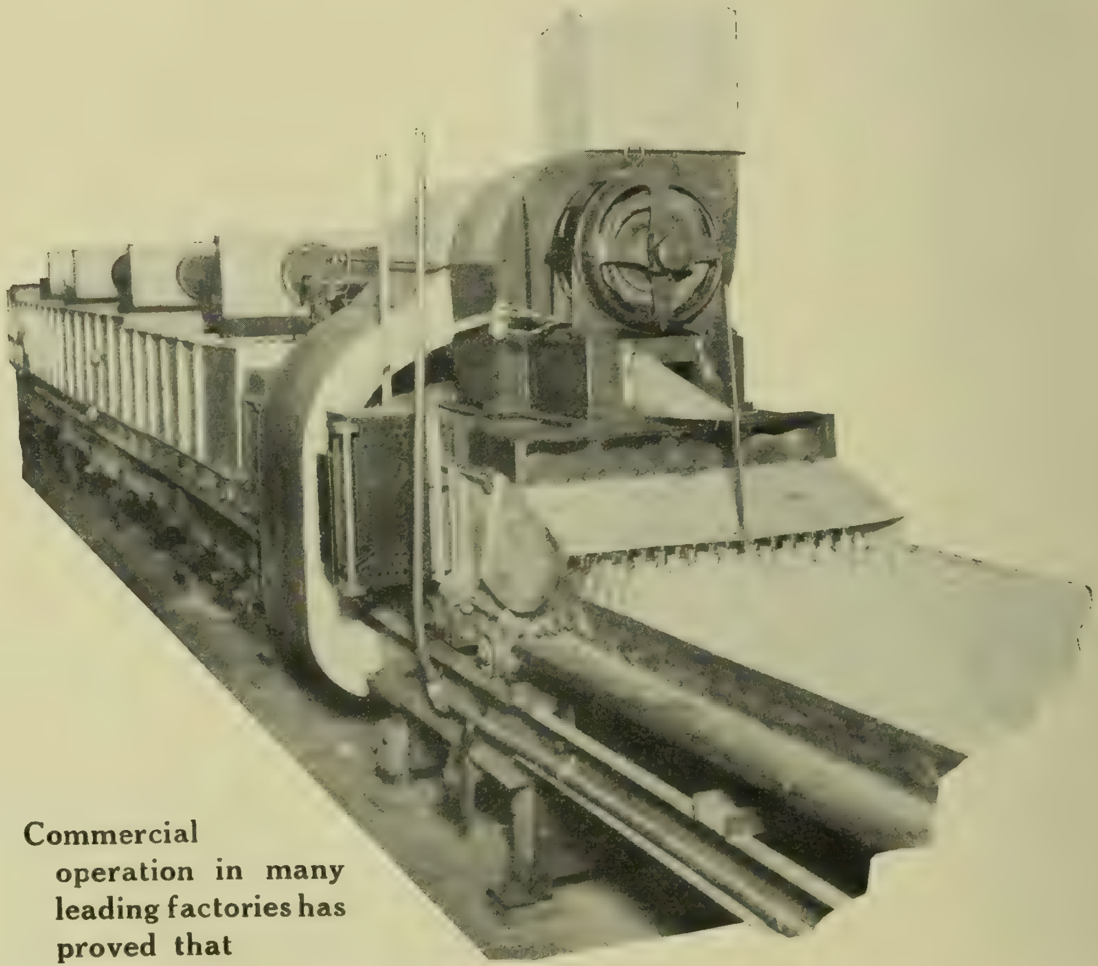
FOSTER INSTRUMENT Co.,
LETCHWORTH, Herts. "The Pyrometer People."
Telephone: Letchworth 26. Telegrams: Resilia, Letchworth.

Another Scientific Development

THE HARTFORD LEHR

IS CREATING

A NEW STANDARD OF ANNEALING



Commercial operation in many leading factories has proved that

THE HARTFORD LEHR

1. Gives **"GRADE A" ANNEALING AT ALL TIMES.**
2. Saves FUEL (as high as 85% saving has been shown).
3. „ WARE (No "Lehr Loss").
4. „ LABOUR.
5. „ SPACE.
6. „ UPKEEP EXPENSE.

The British Hartford-Fairmont Syndicate Ltd.

142-143 Audrey House, Ely Place, London, E.C.1.

"HARTFORD" AUTOMATIC FEEDERS - FORMING MACHINES - LEHRS

The Society of Glass Technology.

The first meeting of the Society of Glass Technology for the Session 1926-27 was held in the University of Leeds, on Wednesday, October 20th, 1926, the chair being occupied by the President, Mr. Walter Butterworth, Senior, M.A.

The General Meeting.

Seventeen applications for ordinary, and three for collective membership were received at the general meeting; nine foreign countries were represented.

The meeting was devoted to a discussion on annealing, the following papers being presented :—

(a) "**Glass Annealing,**" by Dr. J. W. French, F.Inst.P.

The author stated that the first question in any discussion of annealing was the rate at which heat was dissipated by glass at the various temperatures of the annealing process. The second—but not necessarily in order of importance—was the thermal expansion or contraction of the material. The intensity of the stress introduced into glass on cooling, depended, among other things, upon the co-efficient of contraction of the glass. An average value of the thermal linear expansion coefficient for glass was 0.0000085.

The third question to be considered was the thermal conductivity of the glass. If this were infinite, expansion would be quite regular, and there would be no tendency to fracture. However, an average value of the conductivity was about 0.002, whereas the conductivity for copper was 500 times as great. Glass was more liable to crack when heated rapidly than when cooled at the same rate. The other conditions determining the magnitude of the stresses which might be established in glass during the cooling process were :—(4) The molecular cohesion of the material; (5) the viscosity; (6) the existence of a surface layer having properties different from those of the underlying material; (7) the homogeneity of the glass; and (8) the form and dimensions of the glass.

The results of defective annealing in glassware and optical glass were considered; the means of detecting stress were indicated, with special reference to the use of the polariscope, and the methods of annealing were explained. From the optical glass point of view, annealing meant (1) the raising of the temperature to a point just above the softening point of the hardest glass in the charge; and (2) the cooling of the charge at a rate which would not at any one point be sufficient to reintroduce stresses in any of the glasses. That is to say, that, if cooling curves were plotted for all the varieties of glass, the charge should then be cooled in accordance with a curve which was the envelope of all the others. According to a method based on that of Guinand, who was the originator of all the essential features of present-day optical glass manufacture, a pot of glass was allowed to cool down comparatively quickly, the rate of cooling being such that the mass would break into pieces of a workable size. These pieces were chipped to the weight of the required rough blocks, then placed in fireclay moulds stacked in ovens. These ovens were heated until the glass melted down and filled the moulds. They were then allowed to cool at a prescribed rate, from three to four, or in some cases five weeks being allowed for the cooling operation.

An interesting discussion arose from the reading of this paper.

Mr. E. Meigh remarked that Dr. French's statement that glass was more liable to crack when heated quickly than when it was cooled at the same rate was the reverse of his own experience.

Dr. S. English enquired whether there was any evidence for assuming that the whole of a block of glass was not totally amorphous. The polariscope was a very useful and practical apparatus for works use.

Mr. W. Butterworth, Senior, referred to the difficulties encountered in the annealing of different types of glass together, and asked for the sizes of the articles annealed.

Mr. E. A. Coad-Pryor, asked if Dr. French had tried to dissolve off the amorphous layer of glass, and with what result?

Mr. B. P. Dudding observed that the evidence indicated that glass was amorphous all through. If crystals were present they were extremely small.

Dr. C. J. Peddle stated that by checking the annealing by means of a polariscope, one was on extra safe ground, and it was good works practice to examine some bottles from every batch. The polariscope should be employed by a skilled worker.

Mr. G. Simpson asked whether the curved surface of a bottle was liable to show strain which did not exist.

Mr. F. G. Clark observed that the polariscope had been used with advantage in his works for four years.

Dr. French replied to these numerous queries.

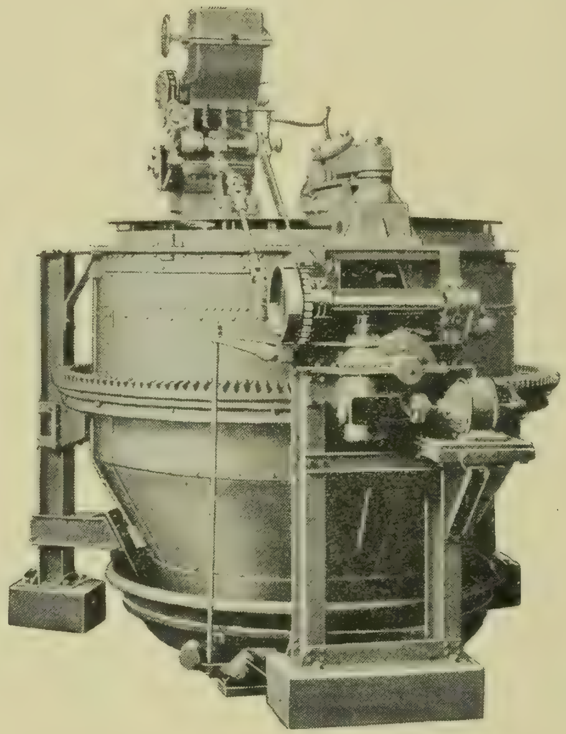
(b) **The Economics of the Annealing Process.** By E. A. Coad-Pryor, B.A.

The author gave an account of experiments in which the Engineering Department and the Research Laboratories of the United Glass Bottle Manufacturers, Ltd., had been recently engaged at Charlton. He stated that ideal cooling curves for glass during the annealing process were difficult to interpret into works practice because they represented the temperature of the glass, not that of the lehr. It was found that, by suitably grading the insulation of the entire lehr, it was possible to carry out rapid cooling without the aid of any induced draught whatever, and further, a lehr could be built which would anneal any size of bottle without any adjustment or damper regulation.

In order to obtain the information necessary for the design of a lehr on a sound theoretical basis, it was essential to determine the amount of heat taken into the lehr by the bottles, and the heat lost through the lehr walls. The author described experiments which had been made to determine these factors. It was found that the heat balance was not greatly affected by an alteration in the weight of the bottle being annealed; if the bottles introduced less heat into the lehr, the annealing time was very much less, and, therefore, they

WELLMAN GAS MACHINES

The quantity and quality of the output of any plant fired with gas, depends on the constant availability of a uniformly rich gas in easily regulatable amounts.



The Wellman Gas Machine alone meets this requirement because of its special mechanical features.

Automatic from non-choking coal feed to ash discharge.

Oscillating Poker ensures the generation of consistently rich gas at all outputs.

Intermittent ash pan motion prevents clinker bridging.

Lowest running costs are obtained with Wellman machines.

Every Glassworks Manager and Engineer should send for our handbook on Gas Making.

THE WELLMAN SMITH OWEN ENG. CORP., LTD.

VICTORIA STATION HOUSE, VICTORIA STREET, LONDON, S.W.1.
WORKS :: :: DARLASTON, SOUTH STAFFS.

Telephones: VICTORIA 7752-3-4.
Telegrams: "PRINCIPIUM, SOWEST, LONDON."

had only to balance the heat in the bottle with that lost from a smaller portion of the lehr. It was not an easy matter to raise the temperature of a body efficiently, from say, 550° C. to 560° C., so it was eventually decided to supply heat to the lehr by means of the slats of the conveyor. An experimental lehr, embodying the principles outlined, was built, and proved to be very interesting and successful. The fuel consumption was about 18 million B.T.U.'s per day, that is, just over 100 gallons of oil, or 1,500 pounds of coal of a calorific value of 12,000 B.T.U.'s per lb.

The lehr was running at about one-third of its maximum speed throughout most of the testing period. The annealing was good throughout. The speed was increased to the maximum, about 10 inches per minute, and the annealing remained excellent, even on quart bottles. This speed represented an output of 450 gross of quarts, or about 40 tons of glass per day.

When once the curtains, which were used to restrict draught up the tunnel, were adjusted to the correct setting, no further adjustments were required. The only work which the operator had to do was to see that the thermo-couple, placed in the slat-heating chamber close to the slats, registered the required temperature. The lehr walls retained their heat for many hours, and if the machines were shut down, and the lehr was run idle for a few hours, the first bottles through, after starting up again, were well annealed.

In the course of the discussion which followed Mr. W. Butterworth asked for further details of the curtains used.

Mr. F. A. Hurlbut pointed out the disadvantages of the type of conveyor used, and described an improved design of conveyor.

Mr. M. Asquith referred to the idea of heating the bottoms of the bottles.

Dr. C. J. Peddle expressed his appreciation of the paper, and remarked that 99 out of every 100 defects in bottles were in the bottoms.

Mr. F. G. Clark asked whether the heating of the slats alone was sufficient when starting up again.

Mr. A. Cousen suggested the heating of the front zone of the lehr by means of electric units when warming up.

Mr. H. V. Renn enquired for the actual annealing curves used.

Mr. E. Meigh said he was interested in the so-called "fireless lehr" designed by the Hartford Empire Company, one of which had been installed in the Greenford Works of the Rockware Glass Syndicate, Ltd. The ideal at which Mr. Coad-Pryor was aiming, namely, to take heat into the lehr with the bottles, was actually achieved in the Hartford lehr. Recently, the time taken for ware to pass through this lehr had been reduced to 43 minutes.

(c) **"The Relationship between Chemical Composition and the Upper Annealing Temperature of Glasses."** By S. English, D.Sc., and Prof. W. E. S. Turner, D.Sc.

Owing to lack of time this paper was taken as read.

The Next Meeting—
Sheffield, November 16 and 17, 1926.

The next meeting of the Society will be one of special importance and interest, for the tenth anniversary of the formation of the Society will be celebrated. A special programme, which will make its own appeal to all who are in any way interested, has been arranged as follows :—

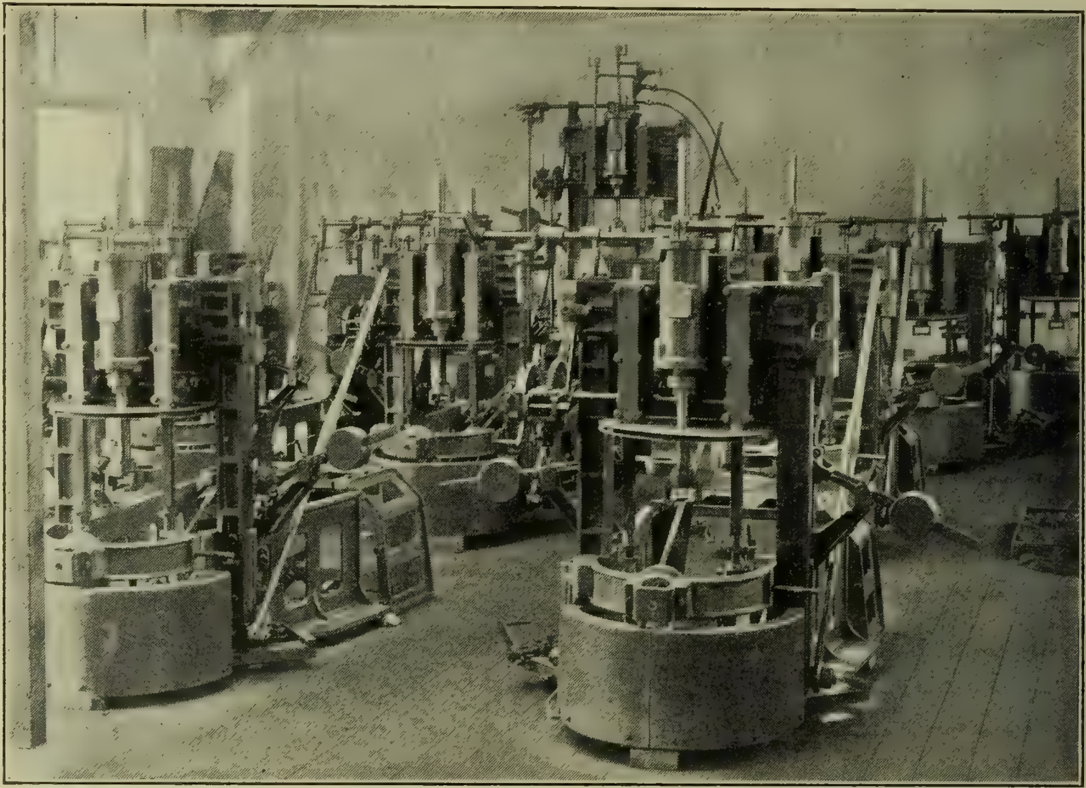
Tuesday, November 16th.
7 p.m. **An Informal Dinner** will be held in the King's Head Hotel, Sheffield.

Wednesday, November 17th.
Morning. **A Visit** will be made to the Glass Works of the British Thomson-Houston Co., Ltd., at Chesterfield.
1 p.m. **Luncheon** at the King's Head Hotel, Sheffield.
2.30 p.m. **General Meeting.**
To be held in the Applied Science Department, The University, St. Georges Square, Sheffield. The Presidential Address will be delivered by Mr. W. Butterworth, Senior, M.A.

It is hoped that members will make every possible effort to attend this meeting, and thus give expression to their appreciation of the work of the Society. Much has already been achieved in the short life of the Society, and a good attendance at this, the tenth anniversary, will not only testify to the keen interest felt by all, but will also give valuable encouragement to those members who are mainly responsible for the conduct of the Society's affairs.

V. D.

Don't Rob
your main Compressor— make it a
Sturtevant Fan to cool your Moulds.
More satisfactory from every viewpoint.
Write for complimentary Catalogues— GL 1019
GL 1241
STURTEVANT
ENGINEERING Co. Ld.
149, Queen Victoria St.,
LONDON
E.C. 4



View of part of a consignment of "Rankin" Feeders recently despatched to Russia.

The "RANKIN" AUTOMATIC GLASS FEEDER

NOTE.

TWO NEW FEATURES.

(1).—All future installations will be supplied with our Patented Rotary Sleeve which eliminates any "cold side" in the glass and ensures perfect distribution.

(2).—We have now arranged special instalment terms whereby we instal and guarantee production in any reputable Factory, and spread payment over a period. This scheme is extremely advantageous to manufacturers as it enables increased production to be made without a large initial outlay. We shall be very glad to give full particulars of this scheme to interested manufacturers on application.

It is acknowledged that the Patented Sleeve Valve gives the most perfect control in delivering measured weights of glass. This basic Patent is **British** in conception, and the "Rankin" Automatic Glass Feeder is **British built** throughout, ensuring continuous production, long life, and the resultant maximum production.

Facts are indisputable, and the following are worthy of mention:

In England wherever "Rankin" installations have been made unqualified success has resulted. The highest percentage of merchantable ware has been obtained, and repeat orders for Feeders constantly result.

In France we have a large and increasing number of Feeders in operation and giving excellent results.

In Germany our patents have been sold to the largest combination of glass manufacturers.

In Australia "Rankin" Feeders have been adopted by the largest Combine in that country; reports of great success on all kinds of bottles are being made.

In Russia, after exhaustive investigations and visits of experts to the United States and England, the "Rankin" Feeder has been adopted as the best, and already a large number of Feeders have been delivered to that country.

In South Africa, Sweden, and many other countries, "Rankin" Feeders are working regularly and giving unequalled results.

THE "RANKIN" AUTOMATIC GLASS FEEDER COMPANY, LTD.,

Tel. Nos.: **Holborn 0140 & 0141.** **1, Charterhouse St., London, E.C.1.** *Telegrams:* **"Natiglaso, London."**

The Decomposition of Glass. Some Minute Formations.

By JAMES SCOTT, M.S.C.I., M.A.C.S., M.E.H.A.

To the popular mind glass is a permanently durable substance; but the technologist is fully aware that it is extremely liable to gradual deterioration as the result of the slow decomposition of its constituents, especially the potash and soda content, through the chemical and mechanical influences of moisture, various atmospherical factors, and acids, etc.

Probably the scientist who has studied this particular phase of glass structures to the greatest extent is Mylius, to whose numerous volumes in this direction the reader is specially referred. On the present occasion the writer will endeavour to render plain some of the most striking effects which have been produced along these lines, after giving a general survey of the manner in which such results accrue, and the agents by means of which the damage is done.

We all know, of course, that specially prepared glass, such as that which is manufactured for the use of analysts, chemical laboratories, etc., must be regarded as occurring in a different category to what may be termed ordinary glass, or that which is intended to serve as window panes, household utensils, and kindred goods, which are, of course, far more common than the previously mentioned sorts.

But even in cases where glass has been specially prepared—for example, some makes of optical apparatus —it has been satisfactorily established that damp air or rather the floating acid-vapours in damp air are capable of exerting very pernicious changes therein.

It is really a curious fact, but one which can be technically demonstrated at any time, that the potash and soda in many forms of glass, are always susceptible to attack from water, probably being reacted upon in an inscrutable manner by the separation of the hydrogen and oxygen components thereof simultaneously with the development of solubility of the respective alkalies. Nature does not always work in a strictly uninterrupted course, such as we obtain in laboratory experiments.

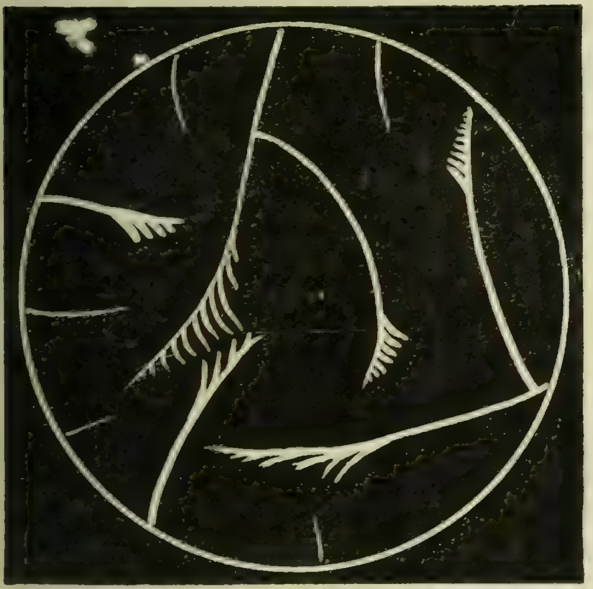


Fig. 1.

A piece of glass one-twenty-fourth inch diameter, showing moderately large scratches terminated with brushy tufts. The lines tend towards forming circles.

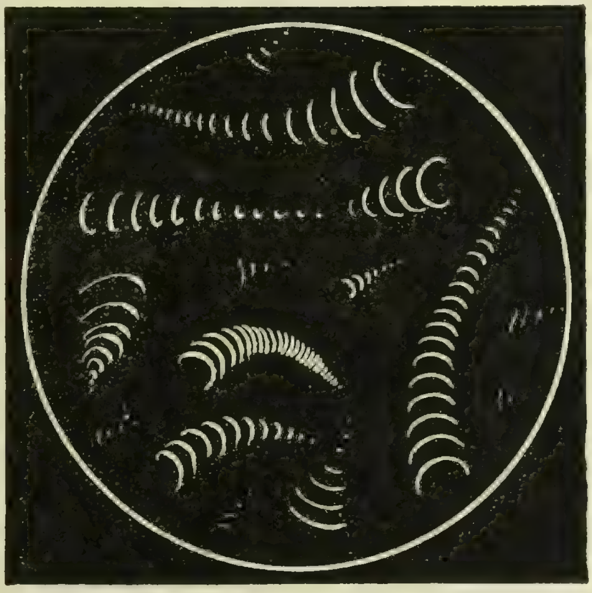


Fig. 2.

A piece of glass one-twenty-fourth inch diameter, showing curved and hook-like fissures of very minute dimensions. They are plainly disposed circularly.

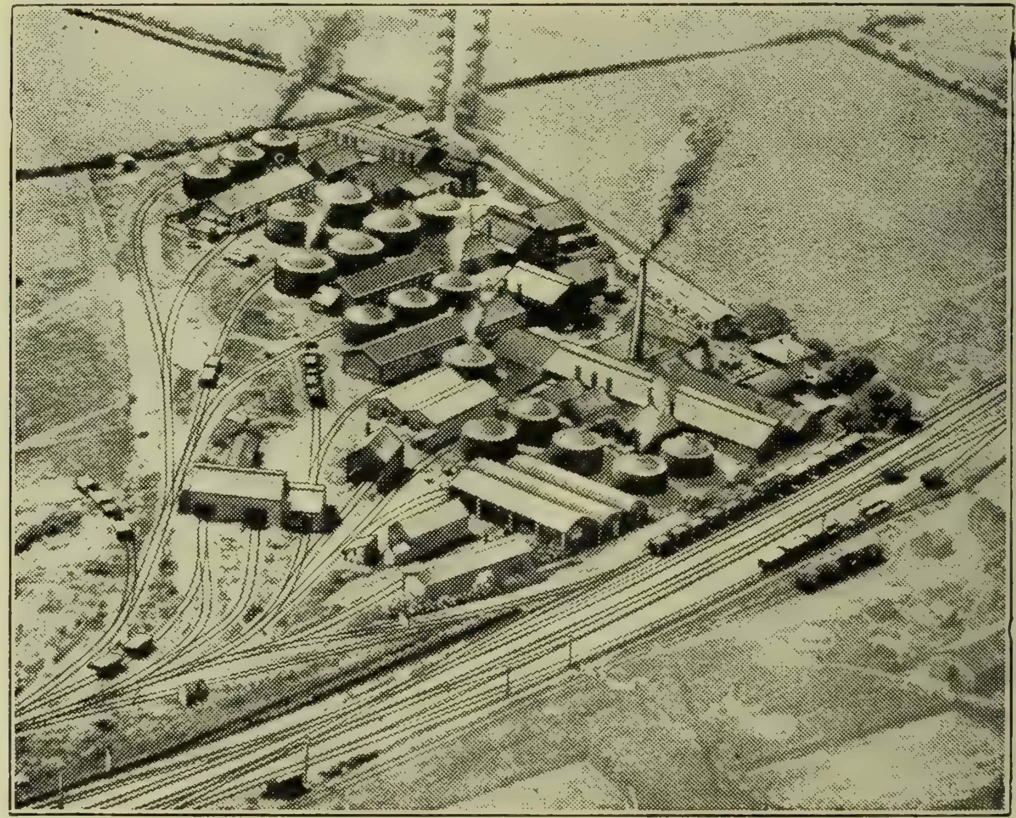
Where acids are concerned with glass the destructiveness is obviously much more understandable; although, even in these circumstances, the actual methods by which they cause particles of the glass to become modified is not by any means so easily explained. The potash and soda, for instance, when once operated on by the elements of the acid, whatever it may be, appear to be rendered capable of dissolving out small proportions of the silica associated so intimately with them, the first named—i.e., the potash—being the most readily converted into a compound therewith.

Flint glass, containing a moderate or else a large

THE MOST DURABLE **BRICK**
MADE FOR **GLASS FURNACES.**

STEPHENS SILICA "C"

EXTREMELY REFRACTORY, TOUGH AND DURABLE.



VIEW TAKEN FROM AN AEROPLANE.

Kiln Capacity 1½ Million Bricks. Works Cover over 9 Acres.

SUPER SILICA CEMENT for setting SILICA BRICK.

Used by most of the principal GLASS WORKS.

STEPHENS & CO., KIDWELLY.

percentage off lead, seem to be the most immune from this form of defectiveness; and thus resists decomposition the longest. Silicates of potash and soda are very soluble, and, the reader will hardly need reminding, are the chief things in water-glass, from which the alkaline content is so freely separable by long storage in damp situations.

Glass vessels in which water, or chemical fluids, are heated or boiled for any noticeable length of time are apparently very readily altered by not only the chemical, but the physical, actions of the various factors entering into the matter, such as vibrations due to ebullition of the contents, etc. The writer personally believes that electrical and magnetic changes occur meantime; but it is exceptionally difficult to substantiate such ideas practically, so will not say any more about them, except that the study of electrons *should* be contemporaneous with that of chemistry.

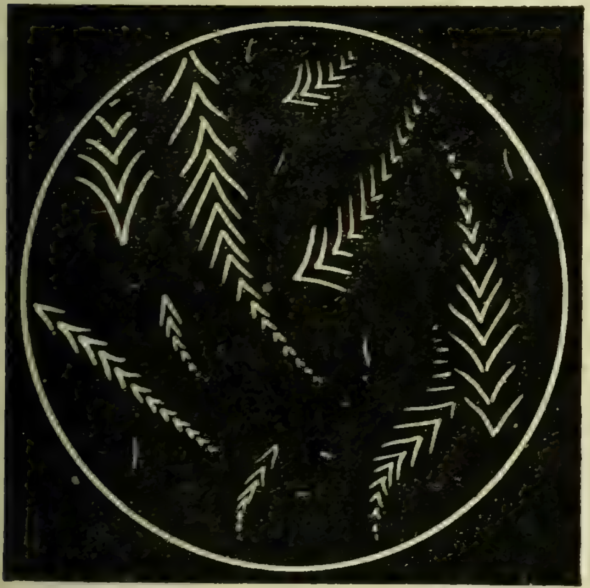


Fig. 3.
A piece of glass one-twenty-fourth inch diameter, showing divergent fissures of very minute dimensions. They tend towards twin-circular formation.

It has hardly seemed the correct procedure to adopt when undertaking investigations into this important aspect of glass to use *distilled* water for experimental purposes. Such methods do not conform with the experiences which glass has to pass through in enduring normal "wear and tear"—so to speak. Even where reputedly distilled water, like rain, is associated with the glass, the water is contaminated by the presence of impurities, both of a soluble and wholly mechanical character, which have been borne down by it during its descent from the heavens to earth. The smallest scraps of grit can be forced, by violent winds, into the tiny, often remarkably shaped, scratches, and cracks made by chemical agencies, and thereby tend to widen them, or cause small fractures that weaken the glass as a whole.

Fissures too small to be discerned by the naked eye, are apt, by yielding to continuous reactions, to join up together in odd-shaped patterns, and consequently produce shallow scales, the detachment of which results in the glass showing unsightly patches which *are* visible without instrumental assistance. Many mirrors have been spoilt in this way.

It is very difficult, as a rule, to learn whether scratches, or decomposition lines, are merely superficial blemishes, or penetrate deeply through the glass. In the latter case they must clearly expose the glass to serious changes, such as sudden fractures, or cumulative splitting, which would not be possible had not the original fine defects first been engendered.

Glass that is extraordinarily liable to decomposition is that which can be readily fused. Those kinds containing only a trifling quantity of lime, or none at all, and a little potash, appear to come into this list. They easily absorb a comparatively large quantity of water from the air, which dissolves the soluble constituents of the material, so that when the glass becomes heated, as with lamp chimneys, it breaks, owing to the expansion of the steam produced by the miniature boiling process thereby occasioned. If such utensils are left for long periods in humid places, unused for their specific purposes, they are the more liable to be shivered to pieces when fitted into the collars of lighted lamps. In some cases, a wrinkled surface skin has been noticed on the glass; and if the decomposition has penetrated deeply this blemish can be peeled off.

It is evident that water does not enter into true chemical combination with the respective elements of glass, but brings about the formation of hydrated products. The process is akin to a *soakage*, with corresponding conversion of the factors, which are in direct contact with one another, into compounds that cannot be properly or adequately described by any known technical name. Extremely minute, totally invisible particles are first acted on; then the substances formed react in a complicated manner with the adjacent items, until faint lines, or specks, obstinately resistant to removal by cleaning and wiping, are brought into existence. Although the observer may follow the subsequent career of the glass by mere ordinary inspection it becomes necessary to use the microscope in this connection to discover the real secret.

It is very difficult, and practically impossible, to be certain of the *direction* which any decomposition marks take, whether they are physically or chemically formed, by the usual methods of inspection, even when magnification is also resorted to. We have, say, a piece of glass—or for that matter a whole glass object—under examination. The level, or maybe curved, surface reveals blemishes such as delicate fissures, scratches, dents, and so forth, but we cannot always be sure whether the "designs" are wholly superficial, or have certain portions of themselves passing downwards *into* the glass. For instance, a faint crack appears to have brush or comb-like tufts along its course; but, instead of this being completely flat, the curved terminals pass downwards *into* the glass, being really *arcs* of incomplete concentric circles seen from above.

This aspect of the decomposition is shown in Fig. 1, and there is no doubt that the whole curved line, in

PARKINSON & SPENCER, Ltd.

Ambler Thorn Fireclay Works,
HALIFAX, YORKSHIRE.

ESTABLISHED 1800.

Telephone : No. 1207.
Telegrams : Parkinson & Spencer, 1207 Halifax

Manufacturers of Refractory Goods of every description for the Glass industry, viz :

GLASS-HOUSE POT CLAY, FIRE CLAY, FIREBRICKS, TANK BLOCKS, BINDERS, etc.

Our Tank Blocks are unsurpassed for quality and durability.

WE SPECIALIZE IN BEST POT CLAY MATERIAL.

New Plant recently erected for the cutting and dressing of Tank Blocks to any dimensions.

FAVOUR US WITH YOUR ORDERS AND YOU WILL BE SATISFIED WITH RESULTS.

AN INEXPENSIVE PYROMETER

for

MEASURING TEMPERATURES BETWEEN 700° & 2,100° C.

Method of using pyrometer.

PORTABLE
ACCURATE
SIMPLE TO USE
QUICK IN ACTION
SELF-CONTAINED
INTERCHANGEABLE LAMP UNIT

Hundreds of these pyrometers are in continuous operation. We shall be glad to send a list of users in your district, together with a copy of List No. 190 V, which describes the instrument in detail.

CAMBRIDGE INSTRUMENT Co. Ltd.

WORKS :-
LONDON & CAMBRIDGE

Head Office & Showrooms — 45, GROSVENOR PLACE
LONDON, S.W.1.

13.

each case apparently intact, consists of *complete* rings, so closely going *down* into the glass side by side, yet too small for individual determination, that, viewed edgeways—like a closely packed tubular spiral spring—the series appears as a line or stroke. The separate items are *too small* to be detected even by the greatest powers of the microscope ; but, eventually, the end rings become larger, less closely associated together, and (seen edge ways or nearly so) look like splayed brushes, or comb teeth.

Hook-patterned scratches can often be noticed in some kinds of glass, and must be, as in the above examples, incomplete circles of small dimensions. They pass through the walls of the glass, and cannot but render it less useful than hitherto. Such defects occur principally in connection with glass which is subjected to alternate heating and wetting. It is probable that similar effects are to be found in window panes where the strong sunlight expands the glass after a shower of rain descends on it. An idea of this phase is given in Fig. 2.

In Fig. 3 is shown a distinctly angular style of decomposition of glass, the series of fissures apparently having their spices right on the surface of the substance, while the sides of the V's diverge downwards, *into* the glass, away from one another.

It should be understood that, however conspicuous defects in glass happen to be, when judged by the naked eye, they must have had a microscopic origin, to the study and observation of which it would seem that too little attention has been hitherto given.

◆

BELGIAN GLASS INDUSTRY.

At the end of October the general condition of the Belgian glass industry was considered as being fairly satisfactory. The plate glass section was especially so, factories working at approximately 90 per cent. of capacity with prices maintained and unchanged.

As regards window glass, hand operated factories were finding difficulty in disposing of their output as the general demand now is for machine drawn glass. This tendency is becoming more and more pronounced, and with the exception of those producing special glass such as for photographic purposes, etc., it is becoming increasingly evident that before long the sheet glass industry will become entirely mechanical. The machine factories are selling their output at net list prices, whilst it is possible to obtain hand blown glass at from 2½ to 6 per cent. under list.

Since the stabilisation of the Belgian franc at 175 to the pound, sterling, the list prices for sheet have been established in foreign currencies on this basis. The bottle industry is reported as being quiet, but business is fair and prices are being maintained, owing to the increases in wages, coal, transport, etc. As an indication of price it might be mentioned that, on the basis of lots of 10,000, the prices of beer bottles in green metal are :—

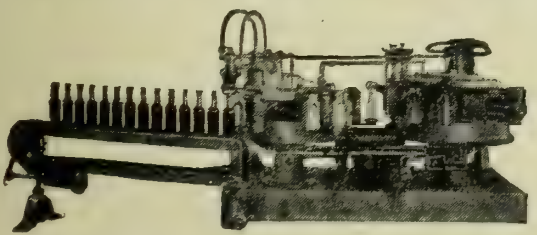
¼ litre	0.63	francs per bottle
⅓ ,,	0.68	,,
½ ,,	0.75	,,
¾ ,,	0.80	,,
1 ,,	0.90	,,

Machine-made wine bottles in green cost 0.90 francs, and in amber 1.00 francs; white flint 1.05 francs. All these prices are at works.

The stabilisation of the franc should assist manufacturers and buyers materially in bringing business to a more uniform level and obviating the heavy influx of orders when the franc fell, followed by cancellations and general falling off if the franc appreciated.

In common with other Belgian industries the glass industry is seriously affected by the British coal dispute. Prior to the stoppage many works operated either partially or entirely on English coal. Now that this source of supply has been stopped they are experiencing difficulty in obtaining fuel, as the high prices ruling in Britain have caused a heavy export of Belgian coal far in excess of the production, so that stocks are being depleted. The result is that the manufacturers are asking for restrictions on the export of coal. Incidentally, of course, prices of coal on the Continent have risen enormously. As an indication of this it may be mentioned that the price of German coal at Rotterdam has recently risen to 60 shillings per ton, and this, of course, for large quantities.

AUTOMATIC NARROW NECK AND WIDE MOUTH BOTTLE BLOWING MACHINE



May be Worked on Floor Level—No Pit Needed

No Transfer Boy. No Take-Out Boy.

STRICTLY AUTOMATIC

When Operated with Mechanical Feeding Device.
Can be Worked by Hand Gatherers. Speed 10 to
32 Bottles per minute, ranging in size from ¼ oz.
to Gallon

LYNCH GLASS MACHINERY COMPANY,
ANDERSON, INDIANA, U.S.A.

Cable Address—"LYNCHNOBOY" ANDERSON
Codes—A.B.C. 5th EDITION, BENTLEY'S, WESTERN UNION

DIAMOND SAND

FROM THE

UNITED HOHENBOCKA GLASS SAND MINES

OF

H. WEICHELT & CO.

IS THE PUREST IN THE WORLD

SILICA	99.931%	MAGNESIA	0.001%
FERRIC OXIDE	0.009%	TITANIC ACID	0.006%
ALUMINA	0.037%	ALKALIS	0.010%
LIME	0.006%		

CONSISTENTLY UNIFORM.
UNVARYING GRAIN SIZE.

Makes the most Brilliant Glass and *saves* Fuel, Decolouriser, Trouble, Time and Money.

No Middlemen! We deal direct from Mines to you.

We satisfy customers all over the World.

May we quote you?

18 72
WEYSS IST DER SAND

H. WEICHELT & CO.,
8, ANTON-GRAFFSTR., DRESDEN, GERMANY.

Some Observations of Surface Deposits formed in Glass Furnace Regenerators.[*]

By HERBERT INSLEY.

ABSTRACT.

Two high alumina refractory bricks which had been used in glass furnace regenerators were examined with the petrographic microscope. The deposits formed on the surface of the brick through reaction with the dusts and gases of the furnace atmosphere were found to be composed principally of nephelite, carnegieite, and corundum. Nephelite and carnegieite probably can form only in those parts of glass furnaces where the temperature is considerably lower than that required to melt the glass but corundum may be formed at melting temperatures.

In a paper[†] by Booze and Flint giving the results of tests to determine the relative resistance of different types of refractory brick in glass tank regenerators to alkaline slags, the authors found, for the particular conditions of the tests, that the brick having the highest alumina content gave the best service. Since the efficiency of the alumina brick as checker brick was somewhat lowered because of the accumulation of deposits on their surfaces, and consequent reduction of air passages, it was thought that a microscopic examination to determine the nature and origin of such deposits might be of importance. The results of microscopic examinations are recorded in this paper. Samples of the used brick were obtained through the kindness of Mr. Booze.

In the investigation reported by Booze and Flint the specimen bricks were installed as an integral part of the upper checkerwork of glass tank regenerators. Temperatures in regenerator No. 1 as measured by an optical pyrometer varied from 1100 to 1200° C. (stated as 2000 to 2200° F. by the authors) and in regenerator No. 2 from 985° C. to 1100° C.[‡] The furnace dusts acting on the brick in regenerator No. 1 were high in silica, alumina, alkalis, and lime and the dusts in regenerator No. 2 high in alkalis, lime, and magnesia, and low in silica and alumina.[§]

The specimens examined in this investigation were broken from brick designated by Booze and Flint as of type No. 1 and were reported to contain 34.7 per cent. SiO_2 and 58.6 per cent. Al_2O_3.

The surface of the brick from regenerator No. 1 was covered with a brown and white deposit, in places curled up into waves, and having the appearance of a dirty coral growth. The interior of the brick was composed of needles of mullite ($3Al_2O_3.2SiO_2$,) crystals of corundum (Al_2O_3) and a small amount of glass. The crystals of corundum were observed in masses of friable material and were probably formed by the crystallisation of dehydrated diaspor. The white vitreous border zone between the interior of the brick and the surface deposit contained large, well-developed mullite crystals, a small amount of glass, and a very few corundum crystals. The presence of a smaller amount of corundum in this zone than in the interior of the brick was probably the result of the increase in the rate of reaction between the corundum and glass caused by flux penetrating into the brick from the outside. The mullite occurred in large well-formed crystals while the corundum showed rounded dissolved borders. Very probably, therefore, the mullite developed at the expense of the corundum and was the stable compound in this zone.

Just outside this narrow vitreous zone, however, corundum seemed to be the stable crystalline phase. Here the corundum developed at the expense of mullite and the glass increased in quantity. A small amount of nephelite ($Na_2O.Al_2O_3.2SiO_2$) was present as skeleton crystals.

The formation of corundum here as well as on clay refractories in other parts of glass tanks is due to the dissociation of mullite. Pure mullite, in the absence of other substances, dissociates into corundum and liquid at 1810°C[*], but such active fluxes as soda and lime undoubtedly lower the dissociation temperature greatly.

In the outer, coral-like deposit the most abundant constituent was nephelite. The indices of refraction of the nephelite, as determined, are: $\omega = 1.538$, $\epsilon = 1.532$. These values agree well with those given by Bowen[†] for pure artificial nephelite ($\omega = 1.537$, $\epsilon = 1.533$) and indicate that the nephelite carries little other material in solid solution. Small corundum crystals are present as inclusions.

A schematic representation of the different portions of the brick is given below:

Interior: corundum, mullite, a little glass.

$$\text{Border zone:}\left\{\begin{array}{l}\text{mullite, a little glass, very little corundum.}\\ \text{glass, corundum, a little mullite.}\\ \text{glass, corundum.}\end{array}\right.$$

Surface deposit: nephelite, a little corundum.

The same type of brick after use in the No. 2 regenerator was very different in appearance because the surface deposit was present as a thin brown skin less than 0.5 mm. in thickness. The interior of this brick was, however, the same as that of the brick in regenerator No. 1 except for a somewhat lesser development of mullite crystals, probably due to the lower temperatures maintained in regenerator No. 2.

---

[*] Published by permission of the Director, U.S. Bureau of Standards, Department of Commerce.
Paper presented to *Amer. Cer. Soc.*

[†] *Jour. Amer. Ceram. Soc.*, 7, 594 (1924).

[‡] *Loc. cit.*, footnote p. 595.

[§] *Loc. cit.*, p. 597.

[*] Bowen and Greig, *Jour. Amer. Ceram. Soc.*, 7, 242 (1924).

[†] *Amer. Jour. Sci.*, 33 (4) (1912).

TELEGRAMS:
"GLASMACHIN, ESTRAND, LONDON.
CABLES:
"GLASMACHIN, LONDON"
CODE:
BENTLEY'S.
TELEPHONE:
CENTRAL 5985.

C. SAXTON, A.M.I.E.E., M. IRON AND STEEL INST., Etc.

CONSULTING ENGINEER

Talbot House,
Arundel Street,
Strand, London, W.C.2.

BOTTLE MOULDS

ORDER YOUR MOULDS FROM

E. LUNN & Co., MOUNT STREET, GLASGOW.

Largest MAKERS of MOULDS in the UNITED KINGDOM

Quick Deliveries and Complete Satisfaction Guaranteed.

MOULDS FOR ALL TYPES OF MACHINES SUPPLIED

ALL MOULDS MADE OF CHILLED CASTINGS ONLY.

Telephone— WESTERN 2792.
Telegrams— GLASMOLD, GLASGOW.

ONE OF OUR RECENT TESTIMONIALS—

"We have one set of Ordinary Round Quart Moulds which you supplied to us which have been working for 2½ years. These are still in perfect condition, showing no cracks or any other flaw in the metal. They have been working almost continuously for the above period, only being off the machines for a week or two at a time. We have also other moulds in Square, Oval and special shapes which have been working quite as long as the Ordinary Round Quarts, although not so continuously, and these also are in perfect condition. We have always found your moulds more satisfactory than any others, and the metal you use is much more durable than any supplied by other firms."

Reference on our Testimonial File : A.B. 91.

Trade "TWENTY MULE TEAM" Mark

Granulated

BORAX

Specially refined for
**ENAMELLERS
AND POTTERS**

BRITISH MANUFACTURE.
Guaranteed 99·50/100% pure.

Entirely free
from phosphates.

BORAX CONSOLIDATED LTD,
16, Eastcheap, LONDON, E.C.3.

TRADE NOTES.

The Institution of Fuel Technology will hold its autumn meeting on December 7th and 8th next. On the first day, Sir Alfred Mond will deliver his presidential address, and an inaugural dinner will be held in the evening.

Among the papers to be presented to the meeting are the following :—" Laws of Gas Flow in Furnaces," by Professor W. Groume Grjimailo, of the University of Moscow, " The Combustion of Carbon," by Professor R. T. Haslam, of the University of Massachusetts.

Members of the Society of Glass Technology are cordially invited to the meeting.

◆ ◆ ◆

The Federation of British Industries has sent a letter to the Minister of Health on the subject of the serious effect on trade caused by the high level of local taxation, and calling for a full enquiry into the question with a view to relieving industry, particularly in the necessitous areas.

◆ ◆ ◆

An extraordinary general meeting of British Glass Industries, Ltd., was held on October 29th to pass resolutions to reconstruct and wind up the company and to appoint M. D. Booth, F.C.A., 40-43, Norfolk Street, W.C.2, as liquidator. Under the proposed scheme a new company is to be formed with a nominal share capital of £400,002, divided into 10,666,720 shares of 9d. each. 9,566,376 of such shares (equivalent to £358,739 2s. nominal value) will be issued as fully paid, whereof 3,699,709 (equivalent to £138,739 1s. 9d. nominal value) are to be distributed among the members of British Glass Industries, Ltd., at the rate of one for every one share of 5s. held in that company. The balance of 5,866,667 of such issued shares (equivalent to £220,000 0s. 3d. nominal value) will belong as to 5,800,000 shares to the holders of debenture stock issued by the B.G.I. Consolidated, Ltd., and as to 66,667 shares to the B.G.I. Consolidated, Ltd. The new company to acquire the undertaking of British Glass Industries, Ltd. (subject to its debts and liabilities) and as the consideration the new company is to allot to British Glass Industries, Ltd., or its nominees, 1,033,042 fully-paid shares of 9d. (equivalent to £38,739 1s. 6d. nominal value).

Sir R. Hodge, Bart., presided, and said that the First Debenture holders in Canning Town Glass Works, Ltd., had agreed to accept Ordinary shares in this new company for such Debentures. The new company would secure a complete relief from existing charges on account of Debenture interest and sinking fund, and commission on turnover, and consequently would have materially lower overhead charges.

The resolutions approving the scheme were unanimously adopted.

◆ ◆ ◆

The only dividend paid by the company since its formation in 1919 was 10 per cent. for 1920-21. In the same year a capitalised bonus of 150 per cent. was distributed. In March, 1924, the capital was reduced by cancelling 15s. per £1 share of the issued capital.

Mr. George E. Alexander, O.B.E., has been elected chairman of the United Glass Bottle Manufacturers, Ltd., in succession to the late Sir Ernest Fitzjohn Oldham, and Sir Max Bonn, K.B.E., has been elected deputy chairman.

◆ ◆ ◆

An enquiry was recently sent out by our American contemporary, *Power*, to some 3,000 industrial plants in the United States as to their practice of stoking boilers. The replies received show that nearly 40 per cent. used hand firing, 12.5 per cent. mechanical stokers worked by hand, 35 per cent. automatic stokers, 15.5 per cent. gas or oil burners, and 2.5 per cent. coal dust firing.

◆ ◆ ◆

The production of plate glass in America for September was 11,431,282 sq. ft., a gain of 1,134,548 sq. ft. over September, 1925.

For the first nine months of 1926 the production totalled 100,622,477 sq. ft., an increase of 13,507,341 sq. ft. over the same period in 1925.

◆ ◆ ◆

The St. Gobain company, in association with the Corning Glass Company, have formed another company to make rolled, figured and other special glass in America.

◆ ◆ ◆

During the quarter ended September 25th, 1926, the Hazel-Atlas Company experienced one of the largest earning periods in the history of the company. The operating profit for the three months was $1,602,956.

◆ ◆ ◆

According to Mr. W. H. Boshart, President of the Owens Bottle Company, the company will have the most successful year in its history, with sales 3 million dollars greater than in 1925.

◆ ◆ ◆

Ten machines of the Fourcault type are being installed in the Belle Vernon factory of the American Window Glass Company.

One machine will be used to demonstrate an improvement on the Fourcault method in accordance with a patent recently taken out by the company.

◆ ◆ ◆

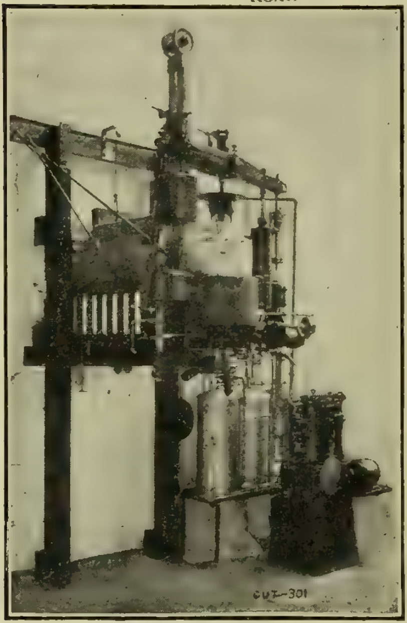
The American Ceramic Society will hold its annual meeting at the Book-Cadillac Hotel, Detroit, Michigan, during the week commencing February 14th, 1927.

◆ ◆ ◆

The new company to be formed to take over Brunner Mond & Co., Ltd., Nobel Industries, Ltd., United Alkali Co., Ltd., and British Dyestuffs Corporation, Ltd., will be called Imperial Chemical Industries, Ltd., and will have an issued capital of £56,802,996, divided into 16,219,306 7 per cent. cumulative preference shares of £1 each (preferential both as to capital and dividends), 31,095,555 ordinary shares of £1 each, and 18,976,270 deferred shares of 10s. each.

◆ ◆ ◆

The exchange rate of the Belgian franc has been fixed by the Government at 172.41 francs to the £, as and from October 23rd, until further notice.



MODEL KfO.

Latest Miller Feeder

PROGRESSIVELY DEVELOPED SINCE 1907.

By arrangement with **The Morgan Crucible Co., Ltd., Battersea,** a stock of all refractory parts for our feeders is now kept in London.

WILLIAM J. MILLER, Inc., SWISSVALE, PA., U.S.A.
London Office : **366, Strand, London, W C.2.**
Tel. No.: Regent 5647.
Cables : Autoglasma, Rand, London.
Autoglasma, Pittsburg, Pa.

TORPEDO *and* WASP-SHAPE TANK FURNACES

(Designed under Moorshead's Patent No. 227,939)

Constitute the LATEST PROGRESS in Tanks.

INCREASE LIFE OF BLOCKS
Avoid stagnant metal.
Save fuel as the corners do no melting.
Ensure smooth running.

By arrangement with Messrs. **U.G.B.,** I can now supply customers in Great Britain and Ireland with these modern types, WHICH ARE SUPERSEDING THE OLD SQUARE TANKS AT MESSRS. **U. G. B. Co.'s** UP-TO-DATE WORKS AT CHARLTON & ST. HELENS, etc.

Send for full particulars and let me quote for altering your old tanks.

TH. TEISEN, C.E.,
FURNACE ENGINEER,
20a, TEMPLE STREET, BIRMINGHAM.
Telephone : Central 1806. *Telegrams : Tete Birmingham.*

The thin outer crust was composed principally of nephelite and carnegieite (the high temperature form of nephelite). The mean index of refraction of the nephelite was 1.540±.002, which is somewhat higher than that of pure nephelite ($Na_2O.Al_2O_3.2SiO_2$) and probably indicates that other substances were present in solid solution. The carnegieite, in its microcline-like twinning and its extinction angles resembled pure carnegieite ($Na_2O.Al_2O_3.2SiO_2$), but its mean index, 1.533±.005, was considerably above the mean index as found by Bowen (1.512). The increase in the indices of the carnegieite was probably also caused by solid solution.

The notable difference in the constitution of the crusts on the two samples of brick is that the sample from regenerator No. 1, operated at the higher temperature, contained nephelite only, while the sample from regenerator No. 2, operated at the lower temperature, contained nephelite and carnegieite. That carnegieite, the high temperature form of $Na_2O.Al_2O_3.2SiO_2$, should form only in the regenerator operated at the lower temperature seems unexplainable until it is remembered that substances such as $CaO.Al_2O_3.2SiO_2$ in solid solution with $Na_2O.Al_2O_3.2SiO_3$ alter the nephelite-carnegieite inversion temperature profoundly.*

It seems probable, therefore, that the appearance of carnegieite in the lower temperature regenerator only is due to the differences in amount and kind of material in solid solution in $Na_2O.Al_2O_3.2SiO_2$ in the two samples.

The occurrence of nephelite and sometimes carnegieite on the surface of refractories above the gas line in the cooler portions of tank furnaces is rather frequent, but so far nephelite has not been observed on refractories above the glass line in the melting end of the furnace. The reason for this may be found by considering the course of the attack of the volatilized alkalis and batch dust alkalis on the refractory. The first material formed will be low in alkalis.† It will have a softening point which is probably well below melting temperatures in the glass tank. Excess alumina crystallizes from this molten glass as corundum. With temperatures equal to those of the melting end of the furnace, the mobility of the liquid will be great and it will flow away from the surface of the brick carrying corundum crystals with it,‡ and consequently there will be no opportunity for silicates containing high percentages of alkalis to form. If, however, the temperature is in the neighbourhood of 1200° C., the viscosity of the silicate liquid will probably be very high, and the liquid will remain on the surface of the refractory where it will have an opportunity to combine with more of the alkalis. The resulting product may be nephelite (or carnegieite) which has a melting point of about 1525° C., well above the temperatures in the cooler portions of the tank.

It is evident, therefore, that in the cooler portions of the furnace protective crystalline formations may be built up on the surfaces of refractories, with fairly high alumina content (50-75 per cent.) while in the hotter portions the same refractories may be corroded away.

Summary.

The microscopic examination of two samples of high alumina refractory brick used in glass furnace regenerators shows that the deposits formed on their surfaces are composed principally of nephelite and carnegieite, the low and high temperature forms of $Na_2O.Al_2O_3.2SiO_2$, and corundum. Nephelite and carnegieite probably form only in those parts of glass furnaces where the temperature is considerably lower than that required to melt the glass. These data as well as those reported elsewhere* indicate that corundum may be formed in the melting end of the furnace.

---

* Bowen, *Amer. Jour. Sci.*, 33 (4), 560 (1912).

† A glass with an approximate composition of $R_2O.Al_2O_3$ $5SiO_2$ is often found on the surfaces of glass refractories in glass furnaces.

‡ Frozen drops of this liquid containing corundum crystals have been observed hanging from the faces of clay refractories in furnaces torn down for repair.

* Insley, *Jour. Amer. Ceram. Soc.*, 7, 589 (1924).

◆

POTTERY AND GLASS AT THE FAIR

Daily Booking of Space despite Handicaps.

Despite the serious effects of the coal stoppage, applications for space in the London Section of the British Industries Fair, which is to be held at the White City from February 21st to March 4th next, have been reaching the Department of Overseas Trade daily. The total area applied for already amounts to more than the whole area occupied at the last Fair, and there is every indication that additional buildings will have to be linked up with those previously used. Early arrangements will have to be made for any such extension, however, and firms are advised to make their requirements known at once.

◆

THE POTTERY AND GLASS TRADES BENEVOLENT INSTITUTION.

The following assistants have satisfied the examiners, and are certified as passing the First Course Examination, and the Board of Management are issuing to them a Certificate of Merit, which carries with it the special privilege of being taken for a week, free of cost to themselves, to the Potteries and the glass areas to see the actual processes used in the two industries :—

Mr. Reginald Reynolds (of Mr. J. O. Roberts, Basingstoke), Miss F. K. Wheeler (of Whiteleys, Ltd., London), Mr. W. A. Smith (of T. Goode & Co., Ltd., London), Mr. A. G. Moors (of J. J. Davies & Son, Newbury), Mr. H. A. Howe (of T. Goode & Co., Ltd., London), Miss E. A. Kay (of Doyles, Ltd., Leeds), Miss G. Bradfield (of Barrett & Co., Cambridge), Miss A. E. Gonnella (of Treron, Ltd., Glasgow), Miss L. Corser (of Hayward & Co., Manchester), and Miss Louise Wade (of Whiteleys, Ltd., London).

An Oil Burning Installation for use in the Glass Industry.

The application of a suitable oil burning installation to the requirements of the glass industry and the discovery of the ideal burner for that purpose presents a number of interesting features.

The conditions which an oil burner has to satisfy may be divided into those common to all forms of combustion plant, and those peculiar to the glass industry.

The general conditions include the following :—(1) Absolute atomization of the oil by the burner itself before combustion begins to take place, using the minimum energy, in the form of compressed air, for this purpose. (2) Complete combustion of the resulting oil-mist, by means of a clean flame, nowhere in contact with the brickwork and making no smoke. (3) A design so arranged that (i) a burner can be constructed to "fit" any size, shape, or type of furnace, and (ii) a flame suitable for each particular job can be produced. (4) Ease of adjustment, flexibility, and absolute reliability.

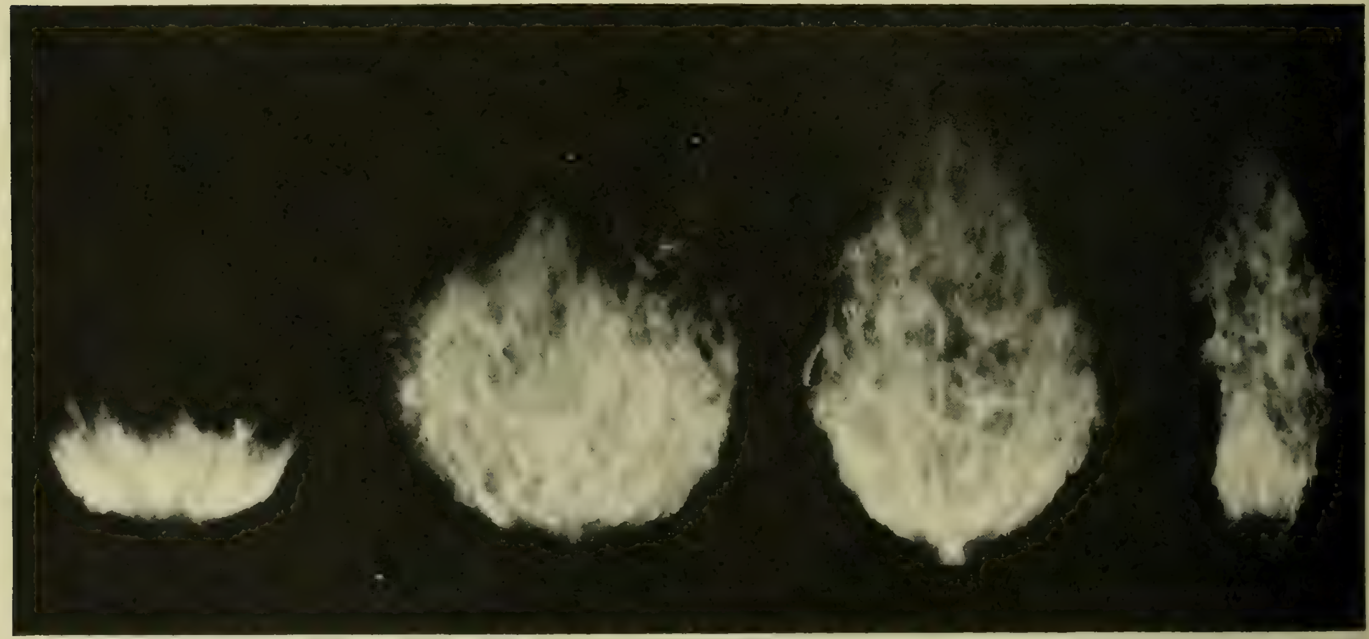


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

But the conditions of the glass industry demand that the burner besides producing a clean and smokeless flame shall be able to maintain the furnace at an even temperature of at least 1200° C.

Atomization in itself presents no great difficulty, but when once it has been obtained the oil-mist must be allowed a perfectly uninterrupted exit from the burner as otherwise the atomization will be ruined by the fine mist coalescing into large drops of oil.

If it is intended to produce a flame of given shape the design of the exit passages would appear to become rather complicated. But, fortunately, this difficulty can be solved as a simple mathematical problem.

Taking these facts as working basis and after practical difficulties had been eliminated by a series of experiments, burners are now being produced which fulfil the specified conditions. The nozzles of these burners are designed to produce flames of definite angles, and the accompanying photographs clearly show that this can be done. These flames were produced by a burner of the same size in each case, the angles of the nozzles being respectively: (i) 60°, about one-third capacity ; (ii) 60°, full on ; (iii) 50° ; and (iv) 30°. This angle is clearly visible in the oil-mist. The flames were burnt in the open, and the exposure of the camera was 1-1000th of a second, which gives an idea of the actual construction of the flame. The oil used was a standard commercial fuel oil.

As already stated a clean and smokeless flame is absolutely essential. That this is the case is clearly indicated in Fig. (v), which shows a wide-angle burner burning in a furnace at about a quarter load. The following should be noted :—(1) The flame is not actually in contact with the nozzle and therefore the nozzle does not get over-heated. (2) The flame is clean as the front of the burner can be seen behind it. (3) This picture was taken from the far end of the furnace, proving the entire absence of smoke.

Figs. (vi), (vii), (viii) give some idea of the flexibility of the burner; the burner and nozzle and the position of the camera were the same in each case. The largest flame measured about 4 feet in length and the smallest about 6 inches. The exposure, about 1-50th of a second, shows the flame as it appears to the eye.

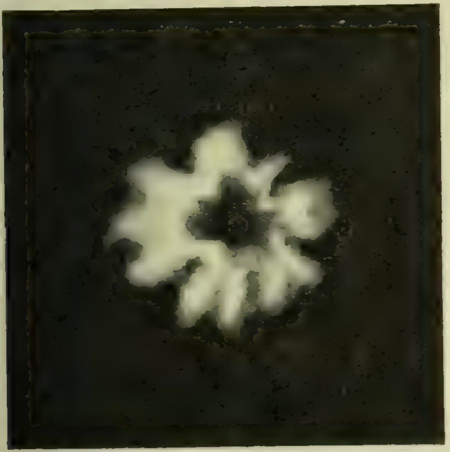


Fig. 5.

The vacuum on the oil supply produced by these nozzles can be as much as 8 lbs. per sq. inch (approx. 16 inches mercury), and because of this it is unnecessary to have a head of more than 6 feet on the oil.

It should be realised that whatever method be used the amount of energy required to break down the skin tension of the oil and to atomize it completely is approximately constant. It is well known that the overall efficiency of a low-pressure blower is not comparable with that of an air-compressor. The reliability of a modern compressor is above reproach, and it is for these reasons that high pressure air is preferred for blowing these burners.

Whilst on this subject of the use of compressed air for oil burners, a few authoritative figures as to the volume of air required for this purpose may be of assistance to many engineers and others who are confronted with the difficulty of being uncertain as to the quantity of air per minute they must allow for when putting in an oil fuel installation. Of course it must be understood that this compressed air is that used for the atomization of the oil and does not include that necessary for combustion, which in the case of glass works is generally pre-heated by means of the hot waste gases from the furnace.

The quantity of air required varies with the type of burner installed, but with the type described in these notes, due to the arrangement of the film screw, swirler, etc., this volume is reduced to a minimum. The basis upon which the calculations are based is one cubic foot of free air per minute at 25 lbs. pressure per gallon of oil per hour. Therefore, a burner with an oil consumption of 30 gallons per hour would require 30 cubic feet of free air per minute at 25 lbs. pressure.

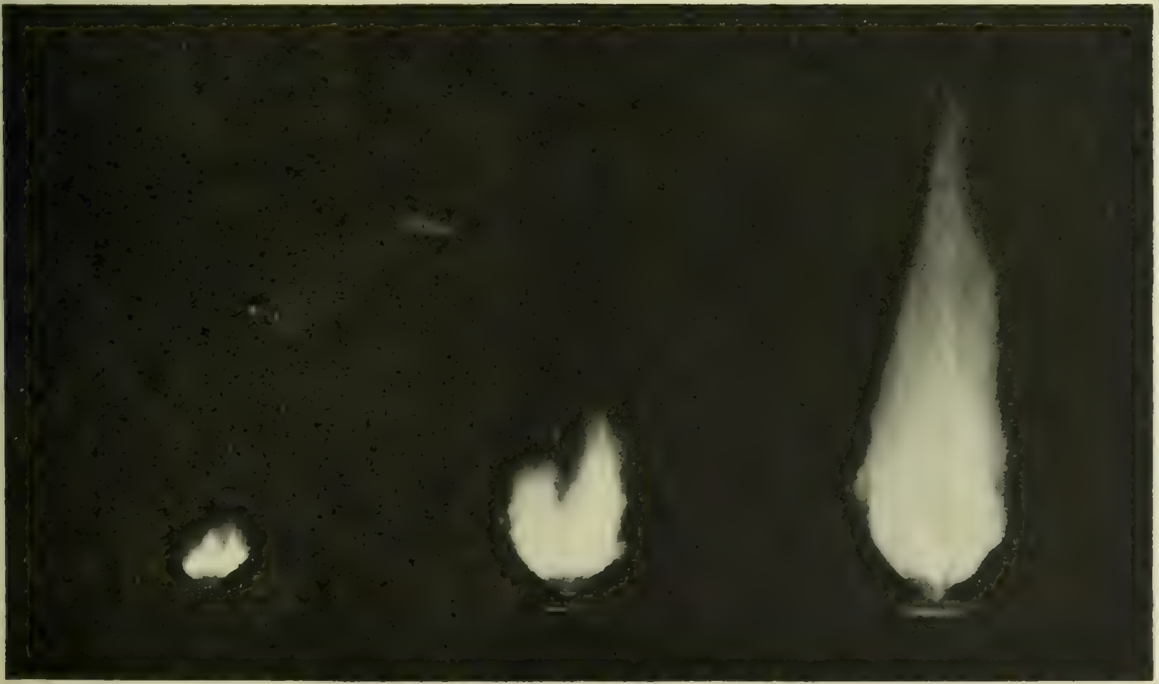


Fig. 6. Fig. 7. Fig. 8.

These burners are designed to work at an air pressure of anything above 20 lbs. per sq. inch, the amount of air which they use is small and the supply could be incorporated with the existing compressed air system.

This figure is very conservative, as recent tests have shown that in actual operation the air consumption figure is somewhat less than that stated, as a 30 gallon per hour burner required 23 cubic feet of free air per

THE LONDON LEAD OXIDE Co., Ltd.

Offices : 107, Bishopsgate, LONDON, E.C.2
Telephone No. : London Wall 4527.
Tele. Address : "Londoxid, Ave, London."

Works : Royal Pier Rd., GRAVESEND, Kent.
Telephone No. : Gravesend 112.

MANUFACTURERS OF

GENUINE **ENGLISH** REFINED

GLASSMAKERS' RED LEAD

Buyers who wish to obtain the very best material at the lowest price should write for samples and particulars.

BRAND
ALOSIL

SILLIMANITE BRICKS

FOR GLASS WORKS

SILICA BRICKS & REFRACTORY GOODS

PICKFORD, HOLLAND & Cº Lº

SHEFFIELD.

Vitreous Enamel Colours.

Stains for Glass.

Oxides for Colouring Glass Metal.

Selenium Metal.

Selenate and Selenite of Soda.

GROUND BONE. FELSPAR. FLINT, FLUORSPAR. QUARTZ, STONE. WHITING, ETC.,

CARBONATE & SULPHATE OF BARYTES

OXIDES OF ANTIMONY. ARSENIC. CHROME, COBALT, SMALTS, COPPER, IRON. MANGANESE, NICKEL, TIN TITANIUM URANIUM, ZINC, ETC

TRADE CERAMIC MARK

WENGERS, LTD.

CERAMIC COLOURS & CHEMICALS

ETRURIA.
STOKE-ON-TRENT.
England.

COLOURS FOR POTTERS, GLAZED BRICK MANUFACTURERS. & GLASSMAKERS.

Samples & Price Lists Sent on Demand

PREPARED ENAMELS FOR CAST & SHEET IRON. COPPER & JEWELLERY,

Limespar.

Phosphate of Lime.

Nitrate of Soda.

Nitrate of Potash.

Opavetro for Opacifying Glass.

Alumina, Oxide and Hydrate.

SILLIMANITE

The High Temperature Resisting Refractory Material.

(*Softening Point above 1800°C.*).

Supplied ground from −10 mesh to −100 mesh. For all bricks, blocks, flue linings, siege coverings, and glasshouse pots and rings.

For the convenience of users who desire to have sillimanite ready prepared with binder, the following mixtures are also supplied dry or ready for use:—

Slip, Pot and Ring Mixtures.
(PROF. W. E. S. TURNER'S Formulæ).

Tank Block, Brick & Pot Mixtures.
(MR. W. J. REES' Formulæ).

Siege Mixture.
(GLASS RESEARCH ASSOCIATION'S Formula).
For lining the floor siege of pot furnaces and general purposes, patching, etc.

The P.B. SILLIMANITE COMPANY, LIMITED,

Sole Agents : PAWLE AND BRELICK.

791, SALISBURY HOUSE,
LONDON WALL, LONDON, E.C.2.

Telephone Number - London Wall 4825.
Telegrams - - PLATOONS, LONDON.

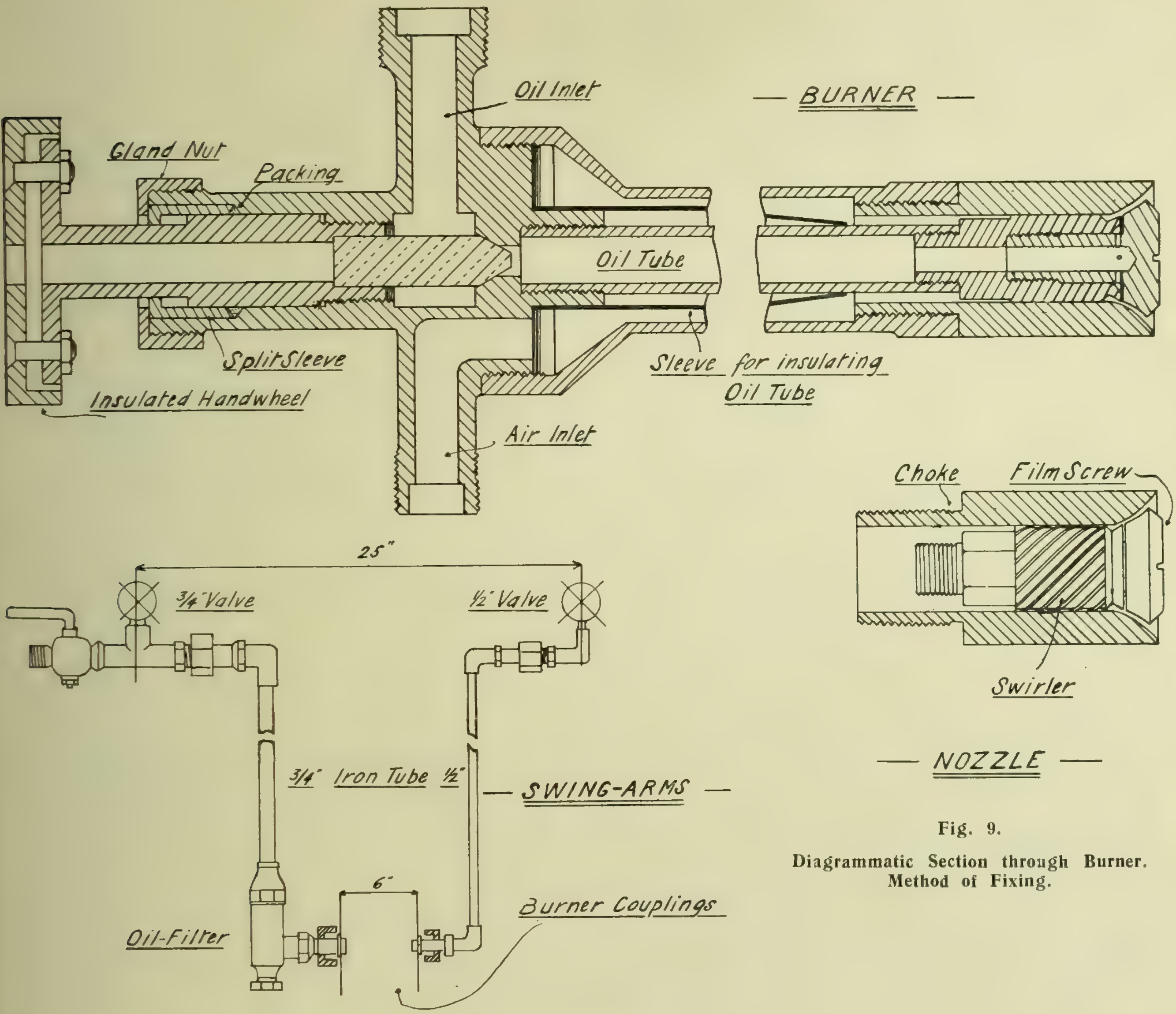


Fig. 9.

Diagrammatic Section through Burner. Method of Fixing.

minute at 35 lbs. pressure, or 0.75 cubic feet per gallon oil per hour.

Coming now to the design of the burners, Fig. 9 gives a diagrammatic section through the burner. It will be noticed that the nozzle consists of three parts: the choke, the swirler and the film screw. Grooves are machined in the periphery of the swirler; these grooves controlling both the quantity and direction of the air flow, also, the width of the resulting flame is determined by the angle of the grooves relative to the centre line of the swirler. The oil passes through the centre of this swirler and the hollow stem of the film screw. It then passes radially between the underside of the film screw head and the end of the swirler in the form of a film, and is here met by the air that has passed along the grooves of the swirler. It is at this point that atomization commences, and the outlet of the burner is of special design in order to allow ready atomization without interference with the direction of flow of the oil mist.

It will be noticed that no small jets are used, but in spite of this the atomization is so complete that the resulting mist will remain in suspension for a considerable period, and therefore facilitates lighting and ensures freedom from carbon deposit.

Before it leaves the works each nozzle is machined to the right setting so that there is no chance of subsequent wrong assembly.

All adjustments of oil consumption are effected solely through the oil valve, which gives a range of from full load to less than half.

We are indebted to Messrs. Laidlaw, Drew & Co., Gilmour Street (Simon Square), Edinburgh, the designers and manufacturers of these burners, for their permission to reproduce the photographs and drawings.

Many Glass Manufacturers
have PROVED the

MANSFIELD
CRUSHERS and GRANULATORS

to be the BEST for

dealing with Manganese Ore,
Limestone, Saltcake, Cullet,
etc., etc.

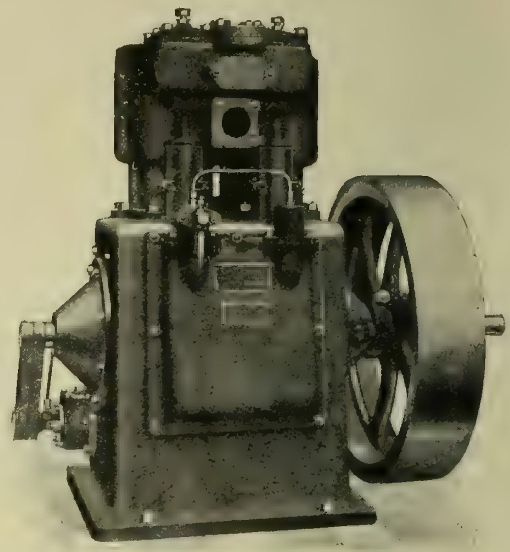
Materials always remain
GRANULAR irrespective of
size.

FRANK MANSFIELD & CO.,
9, REDCROSS ST., LIVERPOOL.

Telegrams :
PRECEDENCE, LIVERPOOL.

Telephone :
4925 BANK

"BROOMWADE"

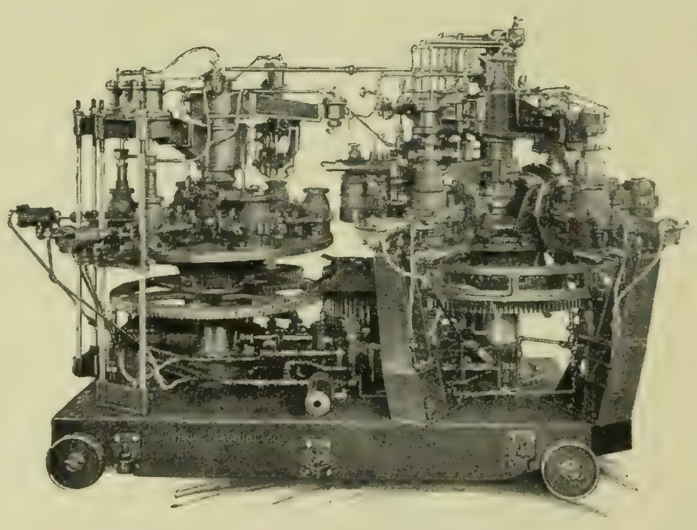


AIR COMPRESSORS

BRITISH AND BEST

FOR ALL DUTIES.

BROOM & WADE, Ltd., HIGH WYCOMBE.



The New O'Neill No. 44 Blowing Machine.

A well-built, high speed blowing machine with a range from 6 oz. to 40 oz. in capacity. Operating speeds up to 23 per minute depending on the class of ware being made. Have our London representative give you the details.

THE O'NEILL MACHINE CO.,
TOLEDO, OHIO, U.S.A.

LONDON OFFICE : 10 SAVOY ST., STRAND, LONDON, W.C.2.

Telephone : Gerrard 7190.

Telegrams and Cables : Oneillany, Rand, London.

FEDERATION OF BRITISH INDUSTRIES TRADE REPORT AND FORECAST.

British industry, after settling down to the new position of affairs created by the coal stoppage, has shown surprisingly small indications of further deterioration. If anything, there has been an improvement from the lowest level. Attention may be called to the contrast between the situation in the "minor" trades and that in the principal basic industries. This is indicated both in the charts of business conditions and employment as well as in the tables given in the F.B.I. barometer.

The foreign trade figures for retained imports of raw materials, exclusive of coal, during the strike months, appear to have been not less in volume than in the corresponding period of 1925, though some reaction was noticeable in imports during September; the latter movement being probably due to the accumulation of stocks owing to the reduced level of production. This seems to *indicate that sufficient stocks should be in hand to enable industry to meet the accumulation of orders for finished goods on the resumption of work.*

Exports of manufactures were substantially on the same level in September as in August, with some improvement over the second quarter, the activity in the minor trades having prevented our exports falling as much as might have been anticipated.

Prices.

The chart of international business conditions shows that the downward movement of gold, wholesale prices, and the cost of living which has been proceeding throughout the year is diminishing in intensity, though it is not easy to determine how far this movement is due to trade cycle influences rather than to the disorganisation of trade and price relations resulting from a continuance of monetary instability in certain important European countries, or to difficulties in obtaining adequate gold reserves in others, while in America the former has no doubt been the predominating influence. In Europe, on the other hand, currency fluctuations have been such a marked feature, notably in France, Belgium and Italy, that all indications of trade cycle fluctuations have been obscured. The rapid appreciation of the currencies of these three countries during the past quarter, together with the publicly avowed intentions of their Governments either to stabilise or pursue a policy of deflation, must involve a readjustment upwards of their production costs and wages, a movement which should do much to reduce their competitive power in foreign markets in the immediate future. At the same time, implying as they do a temporary depression of trade, these readjustments must act as a retarding influence on the recovery of world prices. They must also react indirectly on American prices, where there is already a tendency for agricultural prices to be out of adjustment with industry, a movement which, if continued, may encourage further liquidation.

Money.

The Clearing Banks figures for the past quarter show a steady decline in deposits, whilst advances have been maintained at a level above that of last year and about the same as that of the second quarter. Tax collection and the encroachment on bank balances, due to diminished national income, have no doubt caused a decline in deposits, whilst accommodation on a large scale has been necessary to tide industry and commerce over its present difficulties. In view of the fact that advances now represent 53.8 per cent. of deposits, the question whether the banks will be able to provide the additional accommodation required if trade expands in the near future becomes one of increasing importance, *especially as it may well be that the first trades to expand will not be those which are at the present receiving the major part of the available accommodation.*

The question of the adequacy of the supply of bank credit raises problems of great complexity, as it involves a consideration not only of the sufficiency of the supply of gold for the bank reserves of all gold using countries, but also of our future central banking policy. These problems are exhaustively discussed in what will probably come to be regarded as the most notable document on central banking issued since the War. Namely the Minutes of the Evidence of the Indian Currency Commission. One of the outstanding points which emerges from this evidence is the possibility of a world shortage of gold, arising partly from the inadequacy of the present annual output of new gold, and partly from the official declaration of the representatives of the United States Federal Reserve Board that the vast quantity of gold which accumulated in their country during and since the War is not regarded as superfluous; that is to say, there is little of it to spare for the rest of the world.

Although the evidence laid before the Commission was more concerned with the future than the immediate present it may well be that the pressure of this impending shortage is already being experienced. With so many countries either in the process of stabilising their currencies on a gold basis, or contemplating it, the pressure on available gold supplies must be very great. Just as the drain of gold into the Dutch Indies last year made our return to the gold standard appear unduly precipitate, so the absorption of gold by India and Germany during the current year must be adding to our difficulties at the present juncture.

Forecast (Fourth Quarter, 1926).

The obscurity of the international trade position has been deepened by the continuance of the coal stoppage into the time of year when normally preparations are made for replenishing raw material stocks and placing long term contracts. The coal stoppage must seriously interfere with these operations, and involve some modification of previous estimates of the magnitude and quality of the revival of trade expected to follow a settlement. It is no longer possible to assume that all industries will participate in the movement to the same extent as they would have done had there been an earlier settlement, as it is probable that certain of the changes in the trend of our trade as a whole, and in the future relative level of prosperity of the component industries, will have been accelerated.

So far as the general world position is concerned, the

(*Continued on page* 526.

AIR COMPRESSORS & VACUUM PUMPS

As Illustrated
in 5 sizes
from
10 to 80
cubic feet per
minute

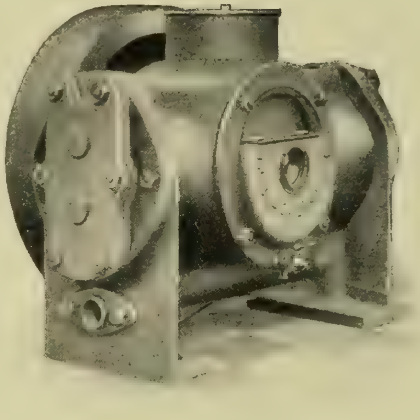
—

Other types
Larger sizes

—

Any Pressure
or Vacuum

—



LACY-HULBERT & CO., LTD.

BOREAS WORKS, BEDDINGTON
NR. CROYDON, SURREY
Telephone: CROYDON 1698.

Moulds

Machined to specification from finest crucible chilled castings by highly skilled craftsmen; our works equipment ensures accuracy and superiority of finish.

SPECIALITIES—

Mould equipment for **Lynch, Miller, O'Neill** and other Automatic Machines.
Glassworks Patterns, Crucible Iron Castings.

ALL ORDERS EXECUTED PROMPTLY.

Johnson Radley & Sons, Ltd.,
Chesney Works, Hunslet, LEEDS.

Telegrams—MOULDS, LEEDS. Telephone—LEEDS 21354.

TECHNICAL BOOKS.

The following are of special interest :—

A TEXTBOOK OF GLASS TECHNOLOGY.
Hodkin & Cousen. 551 pp. 251 Illustrations.
42/- net.

MODERN GAS PRODUCERS.
N. E. Rambush. 545 pp. 356 Illustrations.
55/- net.

THE FLOW OF GASES IN FURNACES.
Groume-Grjimailo. 397 pp., including Appendix on Furnace Design.
27/6 net.

OIL FUEL.
Its Supply, Composition and Application.
E. Butler. 4th Edition. 310 pp. 158 Illustrations.
12/6 net.

INDUSTRIAL FURNACES.
W. E. Trinks. Vol. I. 2nd Edition.
22/6 net.
Vol. II. 405 pp. 292 Illustrations.
27/6 net.

THE DECIMAL PLATE AND SHEET GLASS CALCULATOR.
Samuel S. Lindsay,
Comptroller of the Pittsburgh Plate Glass Company.
29/6 net.

One large glass company estimate they are saving £600 a year in one department by the use of this book.

ANY Technical Book can be obtained from—

GLASS PUBLICATIONS, LTD.,
Talbot House Arundel Street,
Strand, LONDON, W.C.2.
Telephone : Central 5985.

The Economic Manifesto and Empire Trade.

(By OUR CITY CORRESPONDENT.)

The most important events of the past month (apart, of course, from the serious coal trouble) have been the International Bankers Manifesto and the Imperial Economic Conference. The former, no doubt, was timed for publication to coincide with the opening of the latter.

The manifesto has been termed a "Bankers" manifesto owing to the fact that the most prominent of the world's bankers figure among the signatories, and they may have been the main inspiration of the document; but there are other names of great importance in the list. For example, Sir Arthur Balfour, of Sheffield, who is Chairman of the Board of Trade Committee on Industry and Trade which was set up in July, 1924, and conducted such an exhaustive survey of the position and prospects of British industry and commerce; Lord Weir; Mr. Douglas Vickers; Sir Glynn West; Lord Inchcape; Sir Frederick Lewis; and Col. Vernon Willey (ex-President of the Federation of British Industries).

Broadly speaking, the argument of the manifesto is that Europe is committing suicide. It is popular to contrast the prosperity of protectionist America with the embarrassments of free-trade Britain, but the declaration points out that what we call America is a vast confederation of States with immense internal resources and with no Customs barriers or trade inhibitions between its various States. On the other hand, Europe, which finds in the United States of America such a serious trade rival, is a perfect menagerie of internal trade restrictions, tariffs, embargoes, licences and all the rest of it. Many of these have grown up like Jonah's gourd in a night—in other words, since the War. The wine of nationalism has gone to the heads of politicians, and the result is an extremely serious interference with the interchange of commodities which is vital to the life and production of the older countries. The situation on the Danube can be taken as an object lesson in how things should not be done.

The manifesto does not single out any one country for special criticism. We are all in it. Even Great Britain cannot be acquitted of responsibility, though opinions may differ as to how far her hands have been forced in the matter.

It was not likely that the manifesto would have an enthusiastic reception in any particular country. Every Government will play for position and may shun the risk of taking the lead in a new "freedom of trade" policy. In the presence of such a spectacle as the Spanish embargo on British steel, Great Britain could hardly admit that her interests would be served by publicly disclaiming any intention to increase her tariffs.

Meanwhile, the discussions at the Imperial Economic Conference have fortified with fresh arguments that strong body of opinion in this country which sees in Empire trade a way out of the dangers which threaten us. The ideal held out appears to be that of a self-contained Empire amongst whose constituent States there should be the utmost freedom of trade, while a tariff barrier, if necessary, should be erected round the Empire to counter the tariff barriers of America and other outside countries. It is suggested that an extension of the principle of Imperial Preference would materially help to bring about this kind of economic position. (Obviously Imperial Preference can only be carried further if Great Britain increases the number of her tariffs, and this is where the danger lies.)

But the problem is not so simple as it appears. The tariffs, for example, which Australia has been so busy erecting do not seem altogether consistent with the idea of freedom of trade within the Empire. It may be quite true that there is a substantial preference given to British goods, but this is of little help to our manufacturers in cases where Great Britain happens to be the party mainly concerned in manufacturing some particular class of goods affected. The higher tariffs against foreign products sometimes merely exist on paper, for the simple reason that there are practically no imports of certain goods into Australia from countries other than Great Britain. This kind of thing has been a trouble amongst the older countries. Great Britain may get what is called most-favoured-nation treatment, but it sometimes happens that she is the only nation affected by some duty in question; and, where this penalises her exports severely, she can derive small comfort from knowing that, if some foreign competitor entered the field, he would be confronted with a still higher tariff in the market he was approaching.

However this may be, the average British manufacturer is bound to find many of these political arguments purely academic in their interest. What he wants to know is the likely trend of events in the near future, and on this point it is tolerably easy to speak, so far as Great Britain is concerned. So long as the present Government remains in power (and possibly, therefore, during the lifetime of the next Parliament as well as this) we are likely to see an increasingly wide expression of what may be called the spirit of nationalism. (Imperialism being, of course, nationalism in principle, though on a large scale.) The "Buy British Goods" campaign is certainly making headway, and the advent of the Empire Marketing Board will give it a distinct fillip. The Merchandise Marks Bill, which will probably be on the Statute Book by Christmas, is intended to reinforce this policy by giving the public an opportunity of discriminating between Empire and foreign and home production. The danger lies in an accentuation of the disease which is diagnosed in the Bankers' Manifesto. If our purchases of Continental goods decline, their power to buy from us will most certainly be damaged, and figures as to our exports to the Dominions must not be allowed to mask our very considerable dependence on the buying power of our European customers.

The fact, for example, that British goods are purchased by the population of New Zealand every year to the extent of £17 per head, and by Australia to the extent of £10, whereas the average of European countries is very much smaller, must not be allowed to mask the fact that the populations of New Zealand and Australia are relatively very small. It has been observed that the Channel Islands purchase our goods to the extent of £37 per head per annum. This shows the fallacy of comparisons of this kind, except so far as they show the desirability of increasing the population in British Dominions whose public are such large potential buyers of our goods. The United States may only purchase British goods to the extent of 10s. per annum per head of the population, but this means a much bigger purchase in the aggregate than the Australasian.

But, of course, not every British industry is similarly placed, and every manufacturer will judge the position of things by the facts and needs of his own industry. The glass industry, for example, is bound to bank heavily on Dominion markets and will probably feel encouraged by any political developments which seem to promise increased advantages to its overseas sales.

Pottery Enquiry.

The links between the glass and the pottery trades have always been so close that glass manufacturers will watch with interest the progress of a new Safeguarding of Industries Enquiry which has just been appointed. A Committee under the chairmanship of Sir Philip G. Henriques is to investigate the claim of the British Pottery Manufacturers Federation that tableware of translucent pottery shall be brought within the scope of a Safeguarding tariff. It is understood that the application is made by the Federation in behalf of the English China Manufacturers' Association of Longton. The china industry employs normally about 7,000 people and complains that it is in severe distress largely as a result of the heavy importations of china-ware from Czecho-Slovakia and Germany. Notice of opposition has been given by the China and Glassware Section of the London Chamber of Commerce, whose members have briefed Mr. A. S. Comyns Carr, K.C., with Mr. C. F. Entwistle to appear for them. The applicants will be represented by Mr. Barnard Faraday. It is understood that the opposition will contend that imports of foreign tableware are in bulk not much more than half what they were before the War, and that therefore, if English china is being displaced on the market, it cannot be attributed to abnormal quantities of imports. They will say that the main reason for the falling off in the sales of Longton china is the state of the purse of the buying public, which has opened the door to a newly developed sale of decorated English earthenware tea-sets.

The enquiry is to open on November 15th, and will probably be completed by the middle of December. It is unlikely that there can be any duty imposed at any rate before the next April Budget.

Railway Rates.

The proceedings of the Railway Rates Tribunal are drawing to a close. A last dispute is taking place over the percentage increase which the Companies are entitled to charge on goods traffic over and above the pre-war figure. At present the rates are fixed at a 50 per cent. increase. The Companies claim the right to make it 60 per cent. At present it looks as though they may have their way, in which case a rise in the case of glass freights on the Railways may be looked for in 1927.

Proposed Danish Exhibition.

In the Danish press there has been a propaganda campaign in favour of the purchase of British goods, and the Department of Overseas Trade has now been approached by the Anglo-Danish Society in London with a suggestion that this propaganda might be assisted by an exhibition of British goods in Denmark. The Society offers to organise such an exhibition to take place in Copenhagen in April, 1927, provided sufficient support is forthcoming from United Kingdom manufacturers of goods for which a demand exists or can be created in Denmark. It is understood that tentative arrangements have already been made with the support of a number of prominent Danish business men and that space could be allotted to participating British firms at a low inclusive rate. The Society feels, however, that it cannot go further with the matter without some assurance that adequate support is likely to be forthcoming from our exporters and that a representative display can be created for each industry taking advantage of the proposal.

The Department of Overseas Trade is now laying the matter before various organisations of manufacturers in this country, and it is possible that, in spite of the very large number of exhibitions which our manufacturers are now called upon to take part in, there will be a strong effort made to take advantage of this proffered co-operation from Denmark.

◆ ◆ ◆

FEDERATION OF BRITISH INDUSTRIES TRADE REPORT AND FORECAST.

(*Continued from page 523*).

two most important dynamic factors are still the monetary situation and the trend of world prices. In regard to the former, the arrangements made by Belgium to stabilise her currency, together with the apparent determination of the present French Government to avoid further inflation, and the deflationary movement in Italy, are favourable factors for British trade; while our increasingly adverse trade balance is an unfavourable one as it necessitates not only a partial embargo on foreign investment but holds out in addition the possibility of an active restriction of credit.

The position in regard to world prices is that the trade cycle depression which has been in progress for the greater part of the year still continues. While, under more stable monetary conditions, it might be expected to give way at an early date to an expansion of trade, the adverse influences referred to above impose serious obstacles; and some further liquidation in America appears to be called for.

September Trade Returns.

IMPORTS OF GLASS AND GLASSWARE.

		Quantities.				Value.			
		Month ended 30th Sept.		Nine months ended 30th Sept.		Month ended 30th Sept.		Nine months ended 30th Sept.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)...	value	—	—	—		4,915	4,865	45,349	49,433
Glass Tubing and Rod for all purposes... ...	cwts.	678	624	4,893	5,033	2,042	2,057	15,498	16,848
Illuminating Glassware	,,	17,153	16,827	111,539	117,327	42,825	55,003	294,519	344,458
Machinery Glassware	,,	68	44	215	138	405	384	1,879	1,071
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	51,818	51,112	421,906	449,885	144,080	144,279	1,155,234	1,239,837
Plate and Sheet Glass	,,	103,643	111,825	833,373	986,012	140,752	159,233	1,221,445	1,314,441
Optical Glass (other than worked Elements, e.g. Lenses)	,,	1	1	42	16	121	87	3,441	1,947
Bottles and Jars	gross	111,809	116,724	949,147	1,080,239	71,354	79,697	594 584	665,266
Glass and Glassware not elsewhere specified ...	cwts.	2,359	2,957	17,484	25,008	7,363	8,381	54,674	65,367
Total Value	£	—	—	- -	---	413,857	454,986	3,386,623	3,698,668

EXPORTS OF GLASS AND GLASSWARE (BRITISH PRODUCTS).

		Quantities.				Value.			
		Month ended 30th Sept.		Nine months ended 30th Sept.		Month ended 30th Sept.		Nine months ended 30th Sept.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)...	value	—	—	—	—	4,866	5,633	50 710	52,204
Tubing and Rod for all purposes	cwts.	271	367	2,558	3,531	1,687	2,196	17,286	21,024
Illuminating Glassware	,,	441	532	4,581	4,583	4,523	4,969	42,730	40,435
Machinery Glassware	,,	356	144	3,275	1,890	2,319	1,321	22 779	14,762
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	3,705	2,796	25,773	22,930	34,467	29,936	236,995	230,188
Plate and Sheet	,,	62,513	59 563	607,287	655,339	113,985	114,585	1,162,828	1,198,368
Optical (other than worked Elements, e.g. Lenses)	,,	3	12	75	66	124	307	1,924	1,936
Bottles and Jars	gross	28,743	22,351	250,644	219,374	29,638	19,384	248,617	206,771
Manufactures, not elsewhere specified	cwts.	614	616	5,618	6,502	4,014	3,914	32,906	40,012
Total Value	£	—	—	—	- -	195,623	182,245	1,816,775	1,805,700

EXPORTS OF GLASS AND GLASSWARE (FOREIGN AND COLONIAL MERCHANDISE).

		Quantities.				Value.			
		Month ended 30th Sept.		Nine months ended 30th Sept.		Month ended 30th Sept.		Nine months ended 30th Sept.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)...	value	—	—	—	—	328	408	4,544	4,235
Glass Tubing and Rod for all purposes ...	cwts.	—	—	11	8	1	3	157	114
Illuminating Glassware	,,	241	319	1,360	1,653	1,693	1,772	10,246	12,475
Machinery Glassware	,,	—	—	1	4	—	4	26	104
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	951	1,170	6,796	6,843	6,268	7,495	43,692	46 045
Plate and Sheet	,,	118	87	2,021	3,889	118	188	2,901	4 045
Optical Glass (other than worked Elements, e.g. Lenses)	,,	—	7	33	37	11	66	291	382
Bottles and Jars	gross	2,845	639	19,470	14,580	2,648	903	17,432	12 908
Glass and Glassware not elsewhere specified ...	cwts.	10	19	538	388	87	212	3,166	2 434
Total Value	£	—	—	—	—	11,154	11,051	82 455	82,742

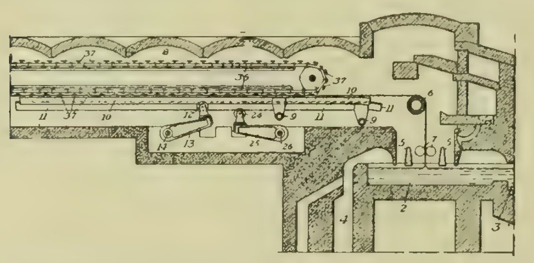
United States Patents.

GRANTED SEPTEMBER 14th, 1926.

1,599,410.—**Furnace Control.** John H. Gillooly, Sewickley, Pa. Filed July 28, 1924. Serial No. 728,589. 24 Claims. (Cl. 236—15.)

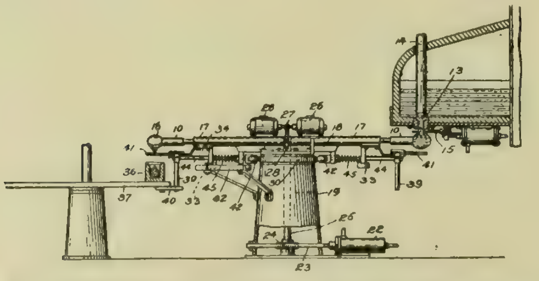
1. The method of controlling furnace combustion which includes causing combustion of at least one unconsumed element of combustion remaining in undiluted flue gas from such furnace, and utilising the resulting increased temperature of the flue gas to control the supply of an element of combustion to the furnace substantially as described.

1,599,647.—**Method and Apparatus for Making Sheet Glass.** Henry F. Clark, Belle Vernon, Pa., assignor to Window Glass Machine Company, Pittsburgh, Pa., a Corporation of New Jersey. Filed July 22, 1924. Serial No. 727,442. 4 Claims. (Cl. 49—47.)



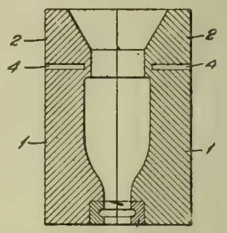
1. Apparatus for making sheet glass including a tunnel, through which drawn glass is adapted to travel a plurality of bars extending along the direction of travel of the glass, and means for imparting to spaced points on the bars similar orbital movements whereby the bars are at times in contact and are moving with the glass and at other times are out of contact with the glass and moving in an opposite direction, certain of said bars being out of time with other of said bars, the mechanism being arranged to maintain the glass in substantially one plane during its movement along the bars.

1,599,790.—**Method of and Apparatus for Delivering Masses of Glass from a Furnace to a Mould.** Carl Henry Rankin, Wellsburg, W. Va., assignor, by mesne assignments, of one-fourth to Charles James Purdie Pratt, London, England. Filed September 11, 1920. Serial No. 409,690. 50 Claims. (Cl. 49—55.)



12. In combination with a moving mould and a glass feeding device, a moveable punty-like member for receiving a charge of molten glass from said device and for delivering the charge to said mould, means for moving said member from a charge receiving to a charge delivering position with relation to the mould, and for moving the member with the mould to maintain the charge in a delivering position with relation to the mould, and shears moving with said member for serving the charge from said member.

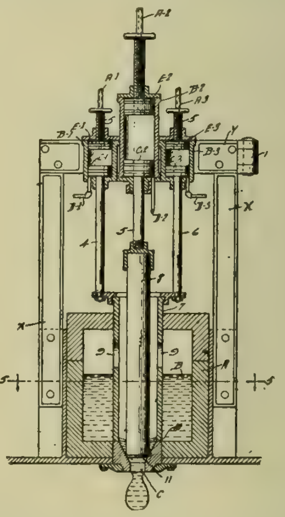
1,600,195.—**Mould for Glassware.** Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed December 18, 1925. Serial No. 76,210. 14 Claims. (Cl. 49—69.)



1. A mould for glassware comprising a body portion, a funnel associated therewith, and means for cooling said funnel.

GRANTED SEPTEMBER 21st, 1926.

1,600,361.—**Automatic Discharge Valve.** Carl H. Rankin, Wellsburg, W. Va., assignor, by mesne assignments, of one-fourth to Charles James Purdie Pratt, London, England. Filed December 6, 1919. Serial No. 342,887. 21 Claims. (Cl. 49—55.)

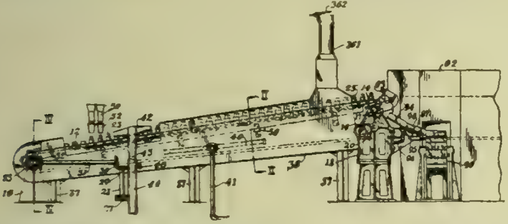


1. The combination with a tank for molten material, having a discharge outlet and a seat around said outlet, of a plunger movable in the tank toward and from said outlet, to eject material therefrom, and a tubular cut-off member surrounding said plunger and movable to and from said seat, said cut-off member having an opening above the level of material in the tank to admit gases to the space between the plunger and said member.

1,600,483.—**Mechanism for Transferring Ware to Lehrs.** Michael J. Owens, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Filed May 11, 1923. Serial No. 638,261. 21 Claims. (Cl. 49—47.)

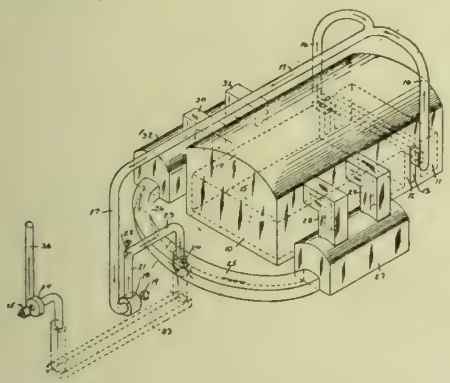
1. Mechanism for conveying bottles or other glass articles comprising an endless conveyor, rolls mounted

to rotate on horizontal axes, and over which said conveyor runs, and holders on said conveyor running around said axes and shaped to receive and hold articles in an

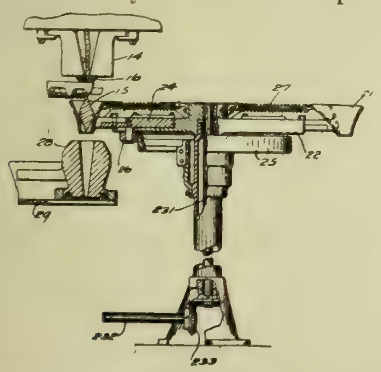


upright position on the upper lead of the conveyor with the articles projecting upwardly from the conveyor, said holders arranged to discharge the articles as they run over one of said rolls.

1,600,484.—**Furnace.** Michael J. Owens, deceased, late of Toledo, Ohio, by Hazel O. Beesch, James C. Blair, and John H. McNerney, administrators, Toledo, Ohio, assignors to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Filed September 20, 1924. Serial No. 738,778. 7 Claims. (Cl. 49—54.)



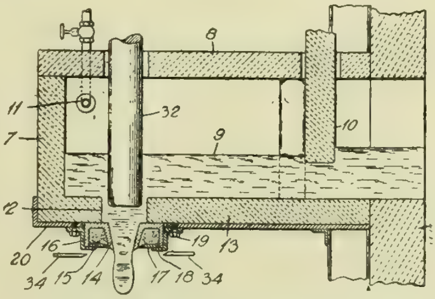
1. The combination of a furnace and a circulating system through which air for combustion is circulated, said furnace comprising a wall having a channel therethrough opening directly to the outside air, said circulating system having its intake at said channel, whereby fresh air enters directly from the atmosphere into said channel, is heated therein and is drawn from thence into the circulating system.



1,600,488.—**Means for Transferring and Guiding Glass into Moulds.** John F. Rule, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Filed April 29, 1918. Serial No. 231,328. 10 Claims. (Cl. 49—5.)

6. The combination with means for forming gobs of molten glass of a continuously rotating mould table, moulds thereon brought successively to charging position beneath the gob forming means, guides moving about a stationery axis in a circular path eccentric to and overlapping that of the moulds, and means to impart to the guides while within range of the moulds, a radial movement without interrupting their movement about said axis, to thereby cause the guides to register with the moulds during an extended portion of their movement, said guides while in register with the moulds being beneath said gob forming means in position to direct the gobs into the moulds.

1,600,962.—**Apparatus for Discharging Molten Glass.** Karl E. Peiler, West Hartland, Conn., assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed May 5, 1921. Serial No. 467,177. 15 Claims. (Cl. 49—55.)



1. In apparatus for separating molten glass into mould charges, a container for the glass provided with a refractory discharge nozzle and an insulating jacket around and extending approximately to the discharge end of the nozzle to conserve the heat of the discharging glass.

GRANTED SEPTEMBER 28th, 1926.

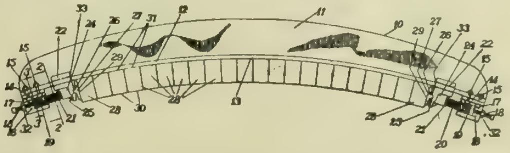
1,601,231.—**Flux for Enamel, Glass and Ceramic Materials.** Henry Blumenberg, Jr., Moapa, Nev., assignor to Stockholders Syndicate, Los Angeles, Calif., a Corporation of California. Filed October 13, 1924. Serial No. 743,472. 2 Claims. (Cl. 106—36.2.)

1. A flux for enamel, glass or ceramic compositions containing boron phosphate.

1,601,232.—**Flux for Enamel Compositions.** Henry Blumenberg, Jr., Moapa, Nev., assignor to Stockholders Syndicate, Los Angeles, Calif., a Corporation of California. Filed October 29, 1924. Serial No. 746,680. 2 Claims. (Cl. 106—36.2.)

1. A flux for enamel, glass or ceramic compound containing alkali metal boron phosphate.

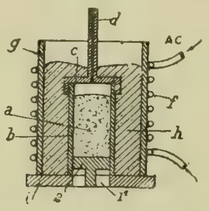
1,601,485.—**Furnace-arch Holder.** Lyle Stockton Abbott, Chicago, Ill., assignor to Chicago Fire Brick Company, Chicago, Ill., a Corporation of Illinois. Filed December 21, 1925. Serial No. 76,776. 23 Claims. (Cl. 110—99.)



1. In a device of the character described, a supporting member, a plurality of refractory blocks lying side by

side and engaging said supporting member and means for yieldingly holding said blocks in engagement with each other comprising a pair of members slidably engaging said supporting member, and means for yieldingly urging said slidable members toward said blocks.

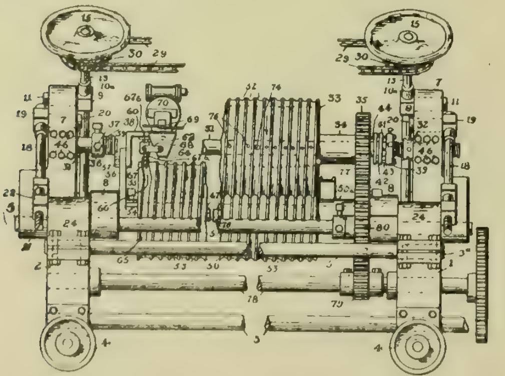
1,601,523.—**Apparatus for the Manufacture of Articles in Silica Glass.** Henri George, Paris, France, assignor to Société Anonyme Quartz & Silica, Paris, France, a Corporation of France. Filed July 15, 1924. Serial No. 726,142, and in France November 2, 1923. 3 Claims. (Cl. 49—1.)



1. An apparatus for the manufacture of articles of silica glass, comprising a crucible of refractory and electrically conducting material adapted to receive the charge to be melted, a housing of electrically insulating material spaced from the crucible and surrounding the same, an electrically insulating and heat resisting material filling the space between the crucible and housing a detachable draw-plate of refractory and electrically conducting material closing the crucible at its lower end, electrical high frequency induction means for simultaneously heating the crucible and the said draw-plate, and means for expelling the charge, in a pasty state, from the crucible, through said draw-plate.

2. In an apparatus for drawing tubes according to claim 1, the provision, upon the cover of the crucible, of an axial tubular member extending within the crucible from one end to the other and bearing upon the detachable plug closing the lower end of the crucible, said tubular member being adapted to produce a bore in the charge expelled from the crucible.

1,601,699.—**Machine for Manufacturing Marbles and Similar Articles.** William J. Miller, Swissvale, Pa., assignor to Victor J. Greene, Pittsburgh, Pa. Filed December 12, 1924. Serial No. 755,499. 40 Claims. (Cl. 49—33.)



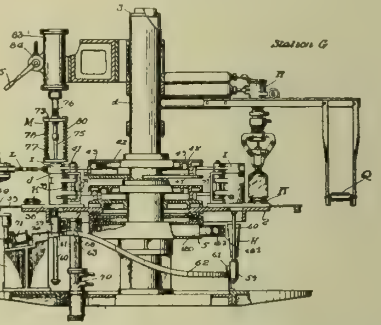
1. In a machine for forming spherical bodies, the combination of a pair of rolls provided with helical peripheral grooves, the axes of the rolls being disposed in a plane oblique to the horizontal, and means for rotating the rolls, the upper roll moving upwardly at the working line of the rolls.

18. In a machine for forming spherical bodies, the combination of a pair of rolls provided with helical peripheral grooves, means for rotating said rolls, and connections whereby the angular relation between the axes of the rolls may be varied while the driving connections subsist.

21. In a machine for forming spherical bodies, the combination of a pair of rolls provided with helical peripheral grooves, masses of the material to be formed being fed to said grooves at one end of said rolls, means for rotating said rolls, and means in addition to the friction of rotation for imparting an initial rotary movement of said masses after their deposit in the grooves.

GRANTED OCTOBER 5th, 1926.

1,601,836.—**Forming Machine.** Thomas Stenhouse, Washington, Pa., assignor to Hazel-Atlas Glass Co., Wheeling, W. Va., a Corporation of West Virginia. Filed November 23, 1923. Serial No. 676,570. 45 Claims. (Cl. 49—10.)



4. In a glass forming machine, means for pressing a glass blank and means for injecting a cooling medium for cooling selected portions of the blank, said cooling medium having a free exit to the atmosphere.

36. In a glass forming machine, a rotary table, a series of sectional neck and body moulds carried thereby, said neck moulds being open at the charging station, a blank mould also carried by the rotary table, a track for elevating the blank mould to its pressing position, a carriage onto which the blank mould passes after leaving the elevating track, a supporting arm adapted to support the blank mould during the pressing operation, means for withdrawing said arm, and means for lowering the carriage when the pressing operation is completed.

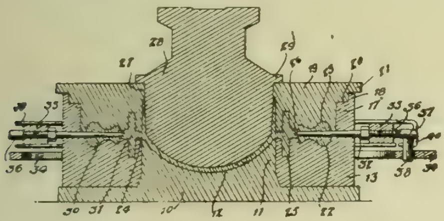
38. In a glass forming machine, a rotary table, a series of sectional body moulds carried thereby, a mould bottom slidably mounted on the table, a reciprocable plunger for moving the mould bottom into alignment with the body mould, and a cam track for withdrawing the mould bottom toward the periphery of the table.

1,601,902.—**Sealing-off Machine.** Cornelis Bol, Eindhoven, Netherlands, assignor to General Electric Company, a Corporation of New York. Filed February 14, 1924. Serial No. 692,853, and in Holland March 19, 1923. 2 Claims. (Cl. 176—2.)

1. In a device of the character described, the combination of a plurality of exhaust heads for holding exhaust tubes side by side, a table mounted to overhang

said heads and to reciprocate along said tubes, said table being heat insulated to adapt it to form the bottom of an oven and having openings through which said tubes may extend above the table, means on said table for fusing said tubes near the top of said table, and manually operable means for at will reciprocating said table.

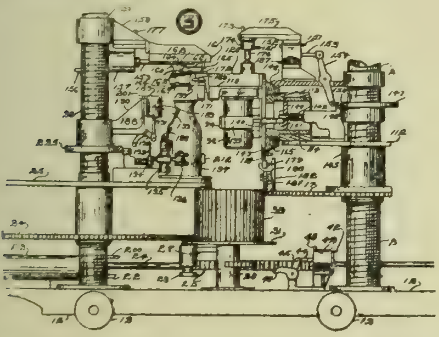
1,602,012.—**Glass Mould.** Shay W. Gooch and William Kenton Yonge, Irwin, Pa., Filed February 3, 1926. Serial No. 85,742. 5 Claims. (Cl. 49—35.)



1. A glass mould comprising a plurality of mould sections pivotally connected at their ends, a series of article forming depressions in each of said sections, a glass receptacle arranged between said sections, grooves arranged in said sections adjacent the depressions and communicating therewith, and means to force the glass from the receptacle to the grooves and depressions, whereby a plurality of series of articles will be formed, each series being connected to a boxing formed by the grooves.

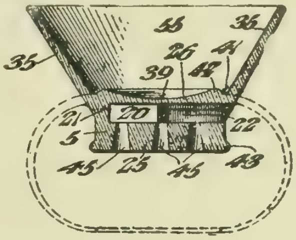
GRANTED OCTOBER 12th, 1926.

1,602,926.—**Glass-forming Apparatus.** Frank O'Neill, Toledo, Ohio. Original application filed August 19, 1918. Serial No. 250,488. Divided and this application filed January 10, 1922. Serial No. 528,264. 39 Claims. (Cl. 49—9.)



1. Glassware forming mechanism comprising a first rotatable carrier, radially disposed guide way means mounted thereon, a bearing permitting movement of the guide way means as to the carrier, a sectional first mould mounted on the radially remote portion of the guide way means, means reciprocaable in the guide way means in addition to the movement of the guide way means as to the bearing for opening the mould, an actuator as to which the guide way means is movable in said bearing, said actuator being operable to effect reciprocation of said reciprocating means in the guide way means, a second carrier eccentric of and rotatable relatively to the first carrier, a second mould on the second carrier for receiving glass from the open first mould on the first carrier, said second carrier mould being movable with the second carrier to approach said open mould on the first carrier, and driving means for rotating said carriers in synchronism to bring said moulds simultaneously toward each other.

1,603,025.—**Method of Moulding Glass and Apparatus Therefor.** Ira M. Clarke, New Martinsville, W. Va., assignor to New Martinsville Glass Mfg. Co., New Martinsville, W. Va., a Corporation of West Virginia. Filed June 7, 1926. Serial No. 114,098. 6 Claims. (Cl. 49—65.)

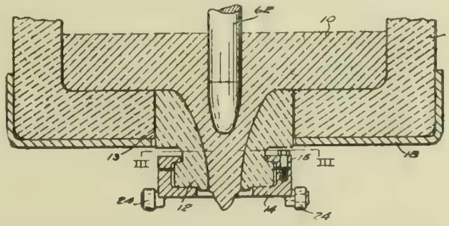


1. The method of moulding a bowl of the character stated, which consists in moulding a bowl blank having a frustrated conical wall, a bottom wall, and a hollow cylindrical member formed integral with the bottom wall and extending in a direction opposite to the direction of the frustrated conical wall, applying heat to the frustrated conical wall of said blank, thereby plasticising the same and lastly reversing the conical wall while in a plastic condition so as to cause said frustrated conical wall to surround said hollow cylindrical member.

2. The method of moulding a bowl of the character stated, which consists in moulding glass in a plastic state around a central core and a series of spaced plugs at a right angle to said core, therewith forming an upper frustrated conical wall and a lower cylindrical member, withdrawing the series of spaced plugs thereby to leave behind a corresponding series of upright apertures in said cylindrical member, and withdrawing the central core member at a right angle to the direction of withdrawal of the plugs, thereby to leave behind a central inner chamber common to and interconnecting the upright apertures.

4. In a mould of the character stated, a base plate, a joint mould mounted upon said base plate, core sections carried by said joint mould and extending inwardly to form a central hollow chamber, movable upright plugs extending through the base plate and connecting with said core section, and means normally to retain said plugs in a retracted position.

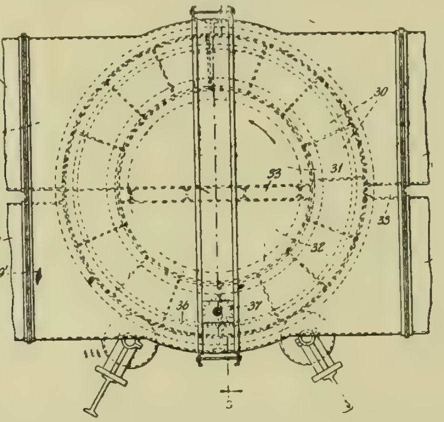
1,603,160.—**Means for Forming Charges of Molten Glass.** Leonard D. Soubier, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Filed June 1, 1920. Serial No. 385,591. 32 Claims. (Cl. 49—55.)



1. The combination of a container for molten glass having a restricted passage-way terminating in an outlet

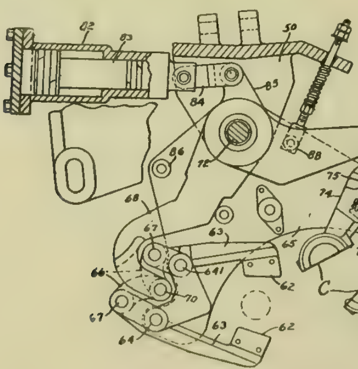
orifice through which the glass is expelled, means to cause an intermittent discharge of glass through said orifice while the latter remains open, comprising a regulator within the glass, and means to cause a periodic movement of said orifice toward and from the regulator while the container remains stationary, the regulator being operable as the orifice moves toward it to force the glass outward and by the movement of the orifice from it to draw the glass inward.

1,603,026.—**Degenerative Air Preheater.** George C. Cook, Millington, N.J. Filed October 24, 1925. Serial No. 64,599. 9 Claims. (Cl. 257—6.)



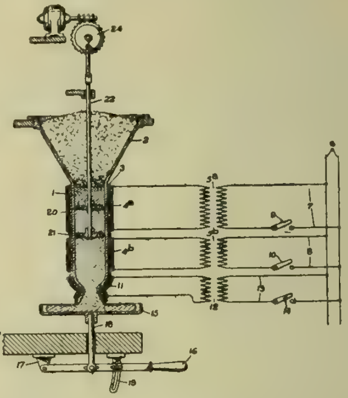
4. A regenerative preheater for air and the like in furnace plants, comprising a casing, an annular mass rotatable therein and composed of alternate flat and corrugated plates with surfaces in planes perpendicular to the plane of rotation to provide substantially radial fluid passages from the periphery to the space within said annular mass, a partition separating the said space, and two pairs of ducts communicating through the annular mass with the respective separated portions.

1,603,196.—**Cutting Apparatus for Glass Feeders.** Albert N. Cramer, Toledo, Ohio, assignor to The Owens Bottle Company, Toledo, Ohio, a Corporation of Ohio. Original application filed August 6, 1920. Serial No. 401,638. Divided and this application filed September 13, 1924. Serial No. 737,481. 15 Claims. (Cl. 49—55.)



1. The combination with means for flowing glass, of cutting mechanism for periodically severing the glass comprising shear blades, levers carrying said blades, a toggle connecting said levers, a pivoted support on which said levers are mounted, means to oscillate said support about its pivot and thereby swing said levers and toggle bodily into and out of a position in operative relation to the flowing glass, a lever arm fulcrumed on said pivot and connected to said toggle, and means to swing said arm and thereby actuate the toggle when in said position and thereby actuate the shear blades.

1,603,221.—**Method and Apparatus for Making Glass.** Elihu Thomson, Swampscott, Mass., assignor to General Electric Company, a Corporation of New York. Filed January 25, 1924. Serial No. 688,603. 5 Claims. (Cl. 49—1.)



1. The method of making glass which consists in feeding glass-making material downwardly into a reaction zone, heating the material in said zone to fusion while protecting the upper zone of said material with unfused material and casting said material downwardly when a clear, glassy material has been formed.

◆

BRITISH PATENTS.

The following abstracts are taken from the Illustrated Official Journal of Patents with the special permission of the Controller of H.M. Stationery Office.

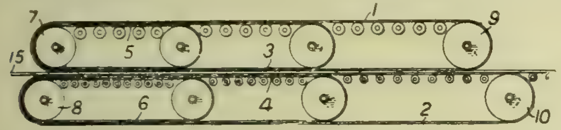
Printed copies of the full specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C., price 1/- each.

256,021.—**Refractory Heat-Insulating Materials.** Haddan, A. J. H., 31, Bedford Street, Strand, London.—(Celite Co.; Los Angeles, California, U.S.A.) June 27, 1925, No. 16612. (Classes 22 and 70.)

Refractory substances, containing diatomaceous earth.—A refractory heat-insulating material consisting principally of silica of higher specific gravity than diatomaceous earth is made by calcining bodies made of a mixture of diatomaceous earth, a catalytic inversion agent such as lime and water. A binder such as ball clay, china clay, or felspar is preferably added to the mixture, and a grog of calcined material may also be added. An example of a composition consists of 93 parts of diatomaceous earth, 5 parts of clay, and 2 parts of quicklime, mixed with 170-180 parts of water, moulded under low pressure, and fired to 1370° C. whereby most of the silica is converted into tridymite.

256,040.—**Glass Manufacture.**—White, A. E., 88, Chancery Lane, London.—(Mississippi Glass Co.; 220, 5th Avenue, New York, U.S.A.; July 17, 1925, No. 18324. (Class 56.)

Annealing.—A method of annealing glass consists in passing the hot plastic glass between heat-insulating walls the conductivity of which increases in the direction of movement of the glass, so that the glass is subjected to slow and gradual cooling. In applying the method to the annealing of sheet glass, the sheet, 15, as it leaves the rolling-apparatus, passes between endless travelling



belts 1, 2 of asbestos which pass over pairs of rollers 7, 8 and 9, 10. Within these belts, shorter belts 3, 4 are arranged, and other shorter belts 5, 6 are arranged within the belts 3, 4. All the belts pass over the end rollers 7, 8 so that the glass sheet passes between heat-insulating walls the thickness of which decreases towards the outlet end. The belts are driven at such a speed that the hot sheet is carried forwards at a rate which allows it to cool slowly and gradually. The upper belts may be in contact with the sheet 15 or they may be arranged a little distance above the surface.

256,188.—**Electric Insulation ; Glass.** Patent-Treuhand-Ges, Fur Elektrische Gluhlampen, 11, Ehrenbergstrasse, Berlin, June 10, 1926, No. 14664. Convention date, August 1, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Classes 36 and 56.)

Electric insulators, are formed from glass which has been devitrified.

256,458.—**Electric Insulators.** Standard Telephones & Cables, Ltd., Connaught House, Aldwych, London.—(Western Electric Co., Ltd., 195, Broadway, New York, U.S.A.) December 21, 1925, No. 32261. (Classes 36 and 56.)

FIG. 8.

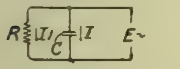


FIG. 9.

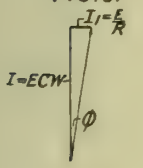


FIG. 10.

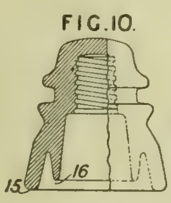


FIG. 11.

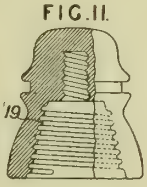


FIG. 14.

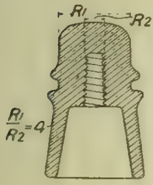


FIG. 17.

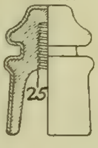


FIG. 23.

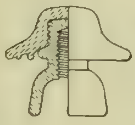


FIG. 29.

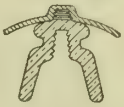
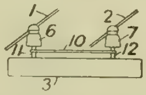


FIG 3.



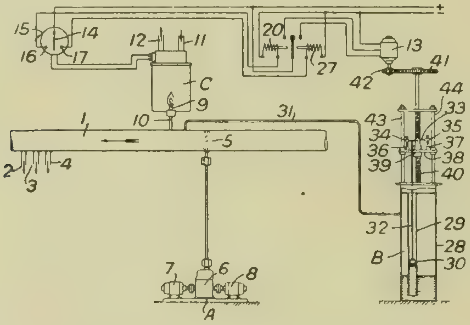
In the methods of transmitting telephonic and telegraphic signals by means of carrier currents propagated along open wire lines, the leakage losses through the insulators are eliminated by the provision of a path 10 of practically zero resistance between the dielectric of one insulator 6 carrying one of the conductors 1, and the dielectric in the insulator 7 of the other conductor 2. The insulators 6, 7, are mounted upon insulating or partially conducting cross arms 3, and metal pins 11, 12 or wooden pins sheathed with metal. The materials of which the insulators are constructed are selected to provide a low dielectric hysteresis loss, and the forms of the insulators are such as to reduce leakage loss in wet weather by a minimum, and to ensure that the capacity effect remains substantially constant in all weathers, The dielectric loss in the insulator is equivalent to a resistance B, Fig. 8, shunted across a condenser C, and the currents I^1, I, Fig. 9, passing through the resistance and condenser respectively, when plotted as a vector diagram give an angle ϕ as a measure of the loss. The insulators are made of a material having a loss angle ϕ of less than 20 minutes for the frequencies employed. As examples of such material glass having a large content of heavy metal, such as lead, antimony or barium is mentioned. One example has the following composition, viz. :—SiO_2, 64.64 per cent. ; PbO, 21.66 per cent. ; NaO_2, 9-10 per cent. ; K_2O, 3.20 per cent. ; B_2O_3, 0.37 per cent. ; and small quantities of P_2O_5, Al_2O_3, CaO, MgO, and fluorine, giving a loss angle of 12 minutes at a frequency of 30,000 cycles. A glass approximating to a boro-silicate glass, such as the glass known as Electrical Pyrex is also used. Various forms of insulators made of these materials are described, their form and proportions being arranged to reduce the leakage losses. The insulator shown in Fig. 10 is screwed on to a wooden pin having a metal sheath, and the insulator has both an exterior flange 15 and an interior flange 16. In that of Fig. II, the interior.19 is corrugated, and adapted for a metal pin of smaller diameter. The capacity of the insulator is reduced by arranging the dimension R_1, Fig. 14, to be four times that of the diameter R_2 of the metal pin ; the thickness of the material above the top of the pin being the same as that round the pin. Further modifications consist in providing the insulator with an outer conducting covering of metal as shown in Fig. 17, which may be pressed against the lower part of the insulator or may stand away from it. In some cases the metal covering is not continued over the top of the insulator so that light may penetrate to the inner surface 25, and prevent bugs and other insects collecting in the cavity. The insulators may also be fitted with umbrella-like covers, Figs. 23, 29, having a flaring rim extending outwardly to protect the outer surface in the neighbourhood of the tie wire from moisture. The under surface of the flaring rim may be corrugated.

256,189.—**Glass Manufacture.** Patent-Treuhand-Ges. Fur Elektrische Gluhlampen, 11, Ehrenbergstrasse, Berlin. June 11, 1926, No. 14770. Convention date, August 1, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)

Production of metal.—Glasses suitable for electric insulation purposes contain, in addition to silica and calcium oxide, at least one oxide of a divalent or trivalent metal, iron oxide being used as a flux. A suitable glass has the following percentage composition :—SiO_2, 67 ; K_2O, 3 ; CaO, 10 ; BaO, 10 ; Fe_2O_3, 10.

256,523.—**Furnaces.** Reineke, J. H., Weitmar, near Bochum, Germany, and Unipressure, Ltd., 701, Salisbury House, London. March 25, 1926, No. 8206. (Class 51 (i).)

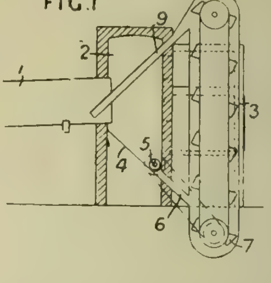
Gaseous-fuel furnaces.—The gaseous fuel supplied to a furnace is maintained at constant " calorific capacity," i.e., the same amount of calories are supplied per unit of time, by a pressure regulator acting in conjunction with a regulator automatically operated in dependence on the heat imparted to a calorimeter by a burner fed by a branch pipe from the main gas supply. The pressure regulator may adjust a valve in the main gas supply, or in a pipe supplying richer gas to mix with a poor gas. The throttle valve 5 in the main gas pipe 1 having branches 2, 3 4 leading to the furnaces, etc., is controlled by a device A of the kind described in Specification 144,304 comprising differential gearing 6 actuated by two motors 7, 8 rotating in opposite directions at speeds controlled by the pressure regulator B. A calorimeter C supplied with water by inlet and outlet pipes 11, 12 and heated by a burner 9 supplied by a heated pipe 10 from the pipe 1 contains a thermo-junction connected to a galvanometer 15 the arm 14 of which engages with one or other of two contacts 16, 17 according as the temperature difference in the pipes 11, 12 is above or below a predetermined value. One of two relays 20, 27 is thus energised, controlling the direction of rotation of a motor 13 driving through gear-wheels 42, 41 a screwed rod 40 of the pressure regulator B. A platform 38 sliding on guide rods 43, 44 engages by a nut 39 with the threaded rod 40 so that this platform is raised or lowered according to the direction of rotation of the motor 13. Pivoted to the platform 38 is a lever 33 carrying contacts 34, 35 and connected by a rod 32 with a float 30 in a pipe 29 the lower open end of which is immersed in liquid in a vessel 28 communicating by a pipe 31 with the gas supply pipe 1. Contacts 36, 37 fixed to the platform 38 are adapted to engage with the contacts 34, 35 as the arm 33 is inclined in opposite directions due to the raising or lowering of the platform 38. The making of one of these contacts causes a resistance to be short-circuited in the circuits of one of the motors 7 or 8 thus increasing the speed of this motor and causing the differential gear 6 to open or close the valve 5 according as the platform 38 is raised or lowered, i.e., according as the calorific value of the fuel is below or above the predetermined value.



256,643.—**Purifying Furnace Gases.** Krupp Grusonwerk Akt.-Ges., F. Buckau, Magdeburg, Germany. August 6, 1926, No. 19514. Convention date, August 7, 1925. Not yet accepted. Abridged as open to inspection under Sect. 51 of the Act. (Classes 1 (iii), 51 (i), and 51 (ii).)

The carbon and impurities in the gases leaving a furnace for oxidising, reducing, chlorinating or sulphating ores or for the volatilization of metals or metal, alloys are removed before the gases are submitted to further treatment by passing the gases from the furnace 1 into a flue 2 where they are subjected to an auxiliary heating device 3 to effect combustion of the carbon. Impurities deposited in the flue slide down a plate 4 to a conveyor 5 which delivers them through an outlet 6 to an elevator 7. The latter returns the impurities with fresh material to the charging device 9 of the furnace.

FIG. I



256,737.—**Glass Manufacture.** Chance Bros. & Co., Ltd., Gell, P. V. W., Gould, C. E., Hampton, W. M., and Martin, H. S., Glass Works, Smethwick, Staffordshire. June 5, 1925, No. 14676. (Class 56.)

Production of metal.—A colourless glass for absorbing ultra-violet rays contains an ingredient which will absorb the rays but will colour the glass, and a second ingredient also efficient in absorbing the rays, which has the property of neutralising the colour imparted to the glass by the first ingredient. In making Crookes glass containing cerium, the yellow colour imparted to the glass by the cerium is neutralised by adding didymium. The proportion of cerium in the batch may be about 3.5 per cent. and that of didymium about 7 per cent.

256,984.—**Bottles.** Mezquita, A. T., 132, Calle Sagunto, Valencia, Spain. August 12, 1926. No. 19944. Convention date August 12, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 125 (i).)

The lower portion of a small or miniature bottle or flask is of cylindrical or slightly conical shape to adapt it for use as a stopper for a larger bottle, with the mouth of which it is adapted to make an hermetically sealed closure by being a ground fit therein or by means of a ring of cork disposed between the stopper and the bottle neck. The miniature bottle may contain a substance complementary to the contents of the larger bottle or a sample thereof and its upper portion may be of greater diameter than its lower part to adapt it to seat upon the upper edge of the neck of the larger bottle.

247,261.—**Furnaces.** Carborundum Co., Ltd., Trafford Park Road, Trafford Park, Manchester :—(Assignees of Hawke, C. E. ; Metuchen, New Jersey, U.S.A.) August 16, 1926, No. 20203. Convention date, August 20, 1925. Not yet accepted. Abridged as open for inspection under Sect. 91 of the Act. (Classes 51 (i) and 51 (ii).)

Linings ; casings and walls ; crowns and roofs ;

hearths; shaft furnaces.—A furnace wall is provided with a lining of refractory material such as silicon carbide of many times greater thermal conductivity than fire-clay having a thickness such that heat is conducted through the lining at a rate which ensures congealing of the material in the furnace in contact with the lining to form a protective covering. As shown applied to a shaft furnace 2, Fig. 1, silicon carbide blocks 3 having air passages 4 are arranged in the melting zone, and a portion of the air blast is drawn from the main air port 6 and supplied by pipes 7 with valves 8 to a distributing ring 9 whence it passes through openings 10 to the air passages 4. The air ducts in adjacent rows of blocks are connected by parts 11 at diametrically opposite sides of the furnace for alternate rows so that the air passes successively through the air ducts to the bottom row which comprises blocks having openings 12 above the ordinary tuyeres 14. The stream of air is so regulated that a layer of solidified slag forms on the blocks, protecting them from erosion. The whole of the air admitted to the furnace may be utilised for cooling the blocks. Fig. 8 shows a melting furnace having recessed hearth tiles 25 of silicon carbide, cooling air passing through the ducts 26 to form a layer 27 of congealed material on the inner surface. The walls 29 and roof 30 are also formed of silicon carbide and cooled by air ducts 31, 32 so that the molten material 28 by volatilisation, splashing or chemical reaction forms a thin layer of solidified material on the sides and roof. The invention may also be applied to the combustion chambers of furnaces, as shown in Fig. 10, where blocks 39 of silicon carbide form the wall between air ducts 34 and the furnace. Air from pipes 33 passes through the ducts 34 which extend through the side walls 35 and the bridge wall 36 and terminate in outlets 37 below the grate 38. Fig. 11 shows a furnace having a stoker of the hopper type, perforated blocks 40 of silicon carbide being provided for introducing air above the grate. The air is supplied from below the grate to ducts 34′, behind silicon carbide blocks 39′, and passes to the fire through the holes in the blocks 40. In each case the cooling is such as to insure congealing of fused ash or slag to form a protective layer between the refractory material and the interior of the furnace.

FIG.10.

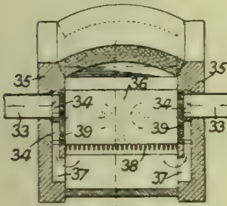


FIG.11.

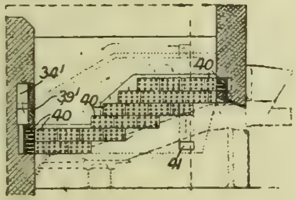


FIG.1.

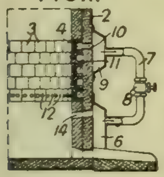
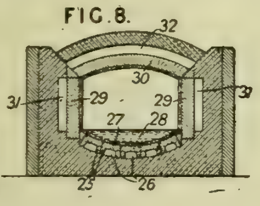


FIG.8.



Latest British Patents.

Applications.

23167—September 20, 1926. F. A. Hurlburt, United Glass Bottle Manufacturers, Ltd. Doors for annealing lehrs, etc.

23272—September 21, 1926. (France, September 22, 1925.) Soc. La Radiotechnique. Low expansion glass.

23522—September 23, 1926. A. Kirby, J. H. Lovell. Machines for bevelling oval, etc. glass plates.

23591—September 24, 1926. J. Bell and Croydon, Ltd. Electric lamp for judging etc. coloured articles.

23666—September 25, 1926. C. Heuze. Polishing glass.

23678—September 25, 1926. H. Bevan. Glazing motor vehicles.

23731—September 25, 1926. (Germany, May 11.) General Electric Co., Ltd. Readily-fusible glasses and enamels.

23998—September 29, 1926. A. S. Davis. Poison bottle.

24095—September 29, 1926. E. V. de Gamage. Milk bottles, etc.

24113—September 29, 1926. B. G. Wade. Attachment for bottles.

24153—September 30, 1926. H. K. Ratzer. G. M. Roberts. Metal caps for glass bottles, etc.

24216—September 30, 1926. J. N. Browne. Bottles, etc.

24189—September 30, 1926. S. G. S. Dicker. (Naamlooze Vennootschap Philips' Gloeilampenfabrieken.) Drawing glass tubes, etc.

24230—October 1, 1926. (United States, October 10, 1925.) Metropolitan Vickers Co., Ltd. Chromium plating.

24574—October 4, 1926. H. J. Hays. Glassmoulding machines.

24669—October 5, 1926. (Germany, October 6, 1925.) International General Electric Co., Inc. Regenerative furnaces.

24828—October 6, 1926. British Thomson-Houston Ltd. Automatic flame control.

24970—October 7, 1926. (France, July 31.) G. Chanel. Manufacture of artistic glass objects.

24971—October 7, 1926. (France, July 31.) G. Chanel. Manufacture of artistic glass objects.

24862—October 7, 1926. G. H. Grimstone. Anti-dazzle glass for vehicle lamps.

25000—October 8, 1926. (Germany, October 16, 1925.) Rhenania-Kunheim Verein Chemischer Fabriken Akt. Ges. Manufacture of glass containing barium.

25050—October 9, 1926. F. E. V. Beanes. Bottles, etc. and stoppers therefor.

25303—October 11, 1926. S. G. S. Dicker. (Naamlooze Vennootschap Philips' Gloeilampenfabrieken.) Process for uniting porcelain and glass.

25266—October 11, 1926. F. E. V. Beanes. Bottles, etc.

25414—October 12, 1926. (United States, October 16, 1925.) W. J. Miller, Inc. Glass fabricating machines.

25431—October 12, 1926. R. Drawe. Gas producers.

25554—October 13, 1926. E. S. Evelyn. Bottles.

25578—October 14, 1926. T. R. Speck. Annealing etc. furnaces.

25612—October 14, 1926. H. V. Hayward. Bottles, etc.

25657—October 14, 1926. S. C. Akehurst. (United States Glass Co.) Food containers.

25754—October 15, 1926. (Germany, October 16, 1925.) F. Carl. Closure devices for bottles, etc.

25787—October 15, 1926. (Belgium, October 16, 1925.) P. A. Favre. Machine for making articles from glass tubing, etc.

25856—October 16, 1926. A. D. Collins. Bottles, etc.

25863—October 16, 1926. (Germany, August 28, 1926.) Siemens and Halske Akt-Ges. Apparatus for chrome plating, etc.

Specifications accepted.

250537—April 11, 1925. Soc. Anon. des Manufactures des Glaces et Produits Chimiques de St. Gobain, Chauny et Cirey. Process and apparatus for the continuous manufacture of reinforced glass.

258313—May 15, 1925. J. Y. Johnson. (Badische Anilin and Soda Fabrik.) Manufacture and production of finely divided metal oxides and silica.

258325—June 15, 1925. F. B. Mitchell. Optical lenses and the like.
258348—June 17, 1925. F. W. Steere. Gas producer or generator.
258412—August 26, 1925. C. A. Klein and R. S. Brown. Manufacture of glass, sand, or flint paper, emery cloth, and like abrasives.
258520—May 27, 1926. H. Wade. (Pennsylvania Wire Glass Co.) Manufacture of wire glass.
258634—April 27, 1925. R. G. Scott and J. A. Donachie. Manufacture of sheets of corrugated glass.
258693—July 6, 1925. E. C. R. Marks. (Danner, E.) Method of and apparatus for the manufacture of sheet glass.
258967—July 7, 1925. Pilkington Bros., Ltd. and J. H. Griffin. Apparatus for washing off the felts of polisher runners in glass-polishing apparatus.
259018—September 19, 1925. W. P. Freeth, and Dairy Outfit Co., Ltd. Apparatus for sealing or closing milk bottles.
259121—March 27, 1926. J. D'Asseler. Method and means for the fixation of glass panes in their frames.
259150—May 31, 1926. L. Mellersch-Jackson (Hartford Empire Co.) Methods of and apparatus for forming sheet glass.
259372—September 28, 1925. S. G. S. Dicker. (Owens Bottle Co.) Machines for forming glassware.
259501—May 28, 1926. C. G. Redfern. (American Optical Co.) Opthalmic lenses.
259502—May 28, 1926. C. G. Redfern. (American Optical Co.) Opthalmic lenses.

Open to Public Inspection.

258541—September 21, 1925. Australian Glass Manufacturers Co., Ltd. Multiple glass stopper pressing machines.
258594—September 19, 1925. Chromium Corporation of America. Chromium plated articles with mirror-like, coloured, or the like surface, and process of producing the same.
258872—September 22, 1925. Soc. la Radiotechnique. Low expansion glass.
259563—October 10, 1925. Metropolitan Vickers Electrical Co., Ltd. Chromium plating.
259568—October 9, 1925. Kalle and Co. Akt-Ges. Sealing-caps, capsules, or capsule-like closures.
259570—October 6, 1925. International General Electric Co., Inc. Regenerative furnaces.

Patents, Trade Marks, Inventions.—Advice, Handbook and Consultations free. King's Patent Agency, Ltd., Director B. T. King, C.I.M.E.; Regd. Patent Agent, G.B., U.S., and Canada, 146a, Queen Victoria Street, E.C.4, and 6, Quality Court (near Patent Office), London, W.C. 39 years' references. 'Phone: Cent. 682.

"Improvements in and Relating to Non-refillable Bottles." The owners of British Patent No. 221667 desire to dispose of the same or would grant a licence to work the invention on royalty terms. Particulars may be obtained from TECHNICAL RECORDS, LTD., 59-60, Lincoln's Inn Fields, London, W.C.2.

"Method of and Apparatus for Forming Sheet Glass." The owners of British Patent No. 126747 desire to dispose of the same, or would grant a licence to work the invention on royalty terms. Particulars may be obtained from TECHNICAL RECORDS, LTD., 59-60, Lincoln's Inn Fields, London, W.C.2.

WANTED IMMEDIATELY.

Expert Lynch Feeder fed Bottle Machine Operators for foreign country. None but thoroughly experienced men need apply. Write giving references Box No. 315, Glass Publications, Ltd., Talbot House, Arundel Street, Strand, London, W.C.2.

CORRESPONDENCE.

To the Editor of GLASS.

Sir.—In the "Trade Notes" of your October issue it is stated that a large plate works have decided that ground lime, if used immediately after grinding, effects economy in melting time and temperature, but in our opinion this statement is rather misleading, unless made with several reservations.

A saving in time and temperature is only a *real* saving if it does not incur expense elsewhere. Now burnt lime must be used immediately if the batch composition is to be kept constant, as it absorbs moisture and CO_2 if stored. Therefore to use it efficiently it would be necessary for a glassworks to produce its own, and the fuel consumed in doing so would more than neutralize the amount saved in the glass furnace. If, on the other hand, burnt lime is brought from a distance to the works and stored, daily tests are necessary to ascertain the amount of moisture and CO_2 taken up, in order that the batch composition may be adjusted to the variation of the lime. It is unnecessary to point out the time and expense involved.

Limestone or Limespar can be stored indefinitely without change in its composition, and, as seen above, is really cheaper in use. In addition, it has the advantage of giving off CO_2, which stirs up the melt and helps to prevent the formation of striæ.

We remain,
Yours, etc.,
18th October, 1926. C. E. RAMSDEN & CO.,
Fenton, Stoke-on-Trent.

IN THE CHANCERY OF THE COUNTY PALATINE OF LANCASTER.

Manchester District.

In the matter of

AUTOMATIC BOTTLE MAKERS LIMITED.

For Sale by Private Treaty.

To GLASS MANUFACTURERS, ENGINEERS, WAREHOUSEMEN, etc.

Excellent Works Site, comprising 6½ acres Freehold and subject to chief. Situated in central position in Trafford Park, Manchester, with private siding connected to main system of Manchester Ship Canal Railways.

Large works buildings containing Gas Producers, Tanks, Lehrs, Machines and Air Compressors, modern three-bay Warehouse, with Automatic Conveyors and convenient loading ways, and splendidly-equipped Machine and Mould-making Shops.

Further Particulars from Receiver and Manager for Debenture Holders, James Blakey, Junior, F.C.A., 42, Spring Gardens, Manchester (City 1115), or Vaudrey Osborne & Mellor, Solicitors, 30, St. Ann Street, Manchester (Central 6078-9).

GLASS

THE RECOGNIZED ORGAN OF THE GLASS INDUSTRY
Published on the Tenth of Each Month.

Single Copies - - - - One Shilling
Annual Subscription - - 10/6 post free

GLASS PUBLICATIONS Ltd.
TECHNICAL PUBLISHERS,

Talbot House,
Arundel Street,
Telephone: CENTRAL 5985. **Strand, London, W.C.2.**

CONTENTS.

PAGE
Editorial Notes ... 539
The Automatic Production of Bulbs and Tubing: The Chesterfield Plant of the British Thomson-Houston Co., Ltd. ... 540
The Use of Compressed Air (*continued*).—By Robert Wilson ... 549
The Patent Ownership Suit: Owens' Interests Involved 555
The Society of Glass Technology: Tenth Anniversary 559
Trade Notes ... 561
A Ten Years' Retrospect.—By Walter Butterworth, Senr., M.A., J.P. ... 563
Reviews ... 571
Society of Glass Technology: The Next Meeting ... 572
October Trade Returns ... 573
United States Patents ... 575
British Patents ... 579
Latest British Patents ... 581

Editorial Notes.

Satisfaction at the collapse of the coal dispute and the prospects of once more being able to obtain adequate supplies of decent fuel and get back into production again have, to a certain extent, diverted the thoughts of the general public from the cost of the stoppage, and also, what is more important still, on whom this cost will fall. If he thinks of the matter at all, the average man supposes that, in so far as it will affect him personally, it means that the probability of a small reduction in the income tax is gone, an increase might even be the result, whilst he will probably have to pay a little more for various and sundry commodities. These may be considered, not only as probabilities, but almost as certainties, yet, unfortunate and unwelcome as they may be in many thousands of cases, they represent only what might be termed the "direct" effects on the individual.

In the industrial districts, particularly those most affected by the stoppage, and hence the least able to withstand them, there will be many indirect effects to be met for a considerable time to come. Amongst these not the least will be the heavy increase in local taxation. This arises from the abnormal increase in poor relief during the stoppage, which in some parts of the country has been so great as to reduce the local Poor Law Authorities to insolvency, or to borrowing on an unprecedented scale.

Now all the debts incurred by these Local Authorities must be paid and there is not the slightest doubt that the next few years will see an increase in local rates.

In most districts the industrial works and factories usually represent the largest proportion of the rateable value, so that such increases will fall heavily on the manufacturers, as assessments are made entirely irrespective of the financial position of the ratepayer and bear no relation to whether a business or manufacturing concern is making a profit or a loss. Consequently, any such increase will at once form an increase in the production costs of the particular article or articles being manufactured.

On the other hand, ever since the War the task confronting British manufacturers has continuously been the one of *reducing* their production costs in order that their products could compete in the world's markets with those of foreign competitors. Due to many reasons, the task has been long and difficult, but in general it may be said that it was being steadily overcome.

Some of the progress that has been made will, however, be cancelled by the additional handicap that these increased rates, etc., will impose on manufacturers, so that the situation calls for efforts, more determined than ever, on the part of everyone in order that the set-back may be wiped out. This applies to the commercial and technical executives as much or perhaps even more than to the actual workmen, who, now that they realise the worthlessness and selfishness of the advice of many of their leaders, show signs of better appreciation of the fundamental necessity for greater efforts. The relations between employers and employed are improving in numerous industries, resulting in a more favourable outlook for the future of those industries, but on the other hand the advantages thus gained must not be lost in other and avoidable directions. By this we refer to those legislative measures which, if brought into operation, will force manufacturers to incur further expenses, immediately reflected in increased production costs. These proposed measures, such as the Factory Bill, etc., whilst no doubt acceptable and in some instances desirable, when industry is in a sound financial position, under present circumstances are simply a menace to improved trade. The whole question is so serious that the Federation of British Industries has sent a long memorandum to the Prime Minister pointing out the dangers, and asking for a delay in the introduction of any further proposals tending to add to the existing, almost crushing, burden.

[GLASS *will deal with all matters pertaining to the industry in an impartial manner, consequently the Editor does not necessarily associate himself with the opinions expressed by his contributors.*]

The Automatic Production of Bulbs and Tubing.

The Chesterfield plant of the British Thomson-Houston Co., Ltd.

The manufacture of glass bulbs for electric lamps is of comparatively recent introduction when judged by the standard of other articles such as bottles and containers; nevertheless, the increase in demand has been so great and rapid that, to produce these bulbs at a rate which will keep pace with present-day requirements, manufacturing methods and equipment have in turn been the subject of really remarkable development. The result is that the productive machines and methods of an up-to-date lamp bulb factory will compare more than favourably with those of any other branch of the industry. We think therefore that the following description of the glass works of the British, Thomson-Houston Co., Ltd., at Chesterfield, will be of interest, the factory having been designed and laid out to produce bulbs and tubing by the latest and most approved devices.

In order to simplify the description it is proposed to commence at the batch mixing room and follow the processes in their natural sequence right through to the despatch of the finished article.

The majority of the raw materials arrive by rail and are discharged into their respective storage bins from whence they are taken as required for mixing, the sand employed (which, by the way, is English) being first passed over a screen of 28 meshes to the linear inch.

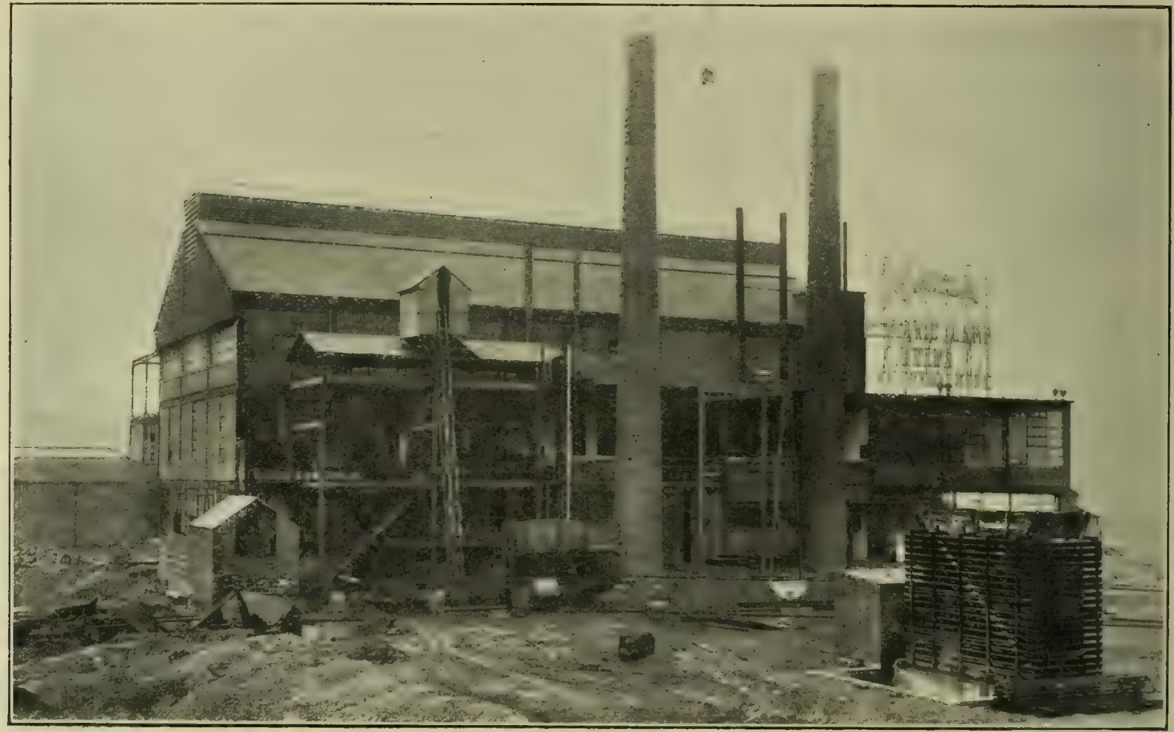


Fig. 1.

General View of Works from Railway.

Showing gas producer house with coal elevator, also water cooling tower in foreground.

Two types of glass are made in the works, the first a lead glass, being used for the making of tubing, the other a soda-lime glass, for bulbs. In order to avoid possibilities of contamination, etc., two separate mixing plants are employed. These are of the Smith type as made by Messrs. Stothert & Pitt and shown in Fig. 2. After being weighed in the correct proportions, the materials are dumped into the skip of the mixer, which is then automatically raised to the next floor, on which the mixers are situated. After mixing the batch is then discharged into a storage hopper with the discharge on the ground floor, these hoppers, one for each mixer, having a capacity of approximately five tons batch. The cullet is mixed with the batch and before use is crushed in a Sturtevant roll jaw crusher.

In the case of the soda lime glass for the bulbs, which process we propose dealing with first, the mixed batch is then transported to a storage hopper over the dog-house of the melting tank. The furnace is of the regenerative type, being arranged for producer gas firing and having two ports either side. Owing, however, to the present difficulties of obtaining adequate supplies of coal, oil burners have been installed as a stand-by, the burners being placed in the end of the tank, one either side of the dog-house.

the factory is brought to the tower, where it is once more cooled, thus effecting considerable economy in the water consumption.

The gas producer is provided with the necessary instruments to ensure the best operating results. These include pressure gauges for the steam to the blast, thermometer for the steam, thermometers and pressure gauge for the blast, and also a thermo-couple inserted in the gas outlet of the producer. This latter, by the way, is a feature which many other works could copy with advantage as a knowledge of the gas temperature is a valuable aid to proper producer operation. The CO_2 content of the gas is automatically recorded by an Alexander Wright CO_2 recorder placed in the furnace room, where chimney draft indicators are also provided alongside the reversing levers for the air and gas valves. (This air valve is of the ordinary butterfly type whilst the gas valve is of a modified Forter type.)

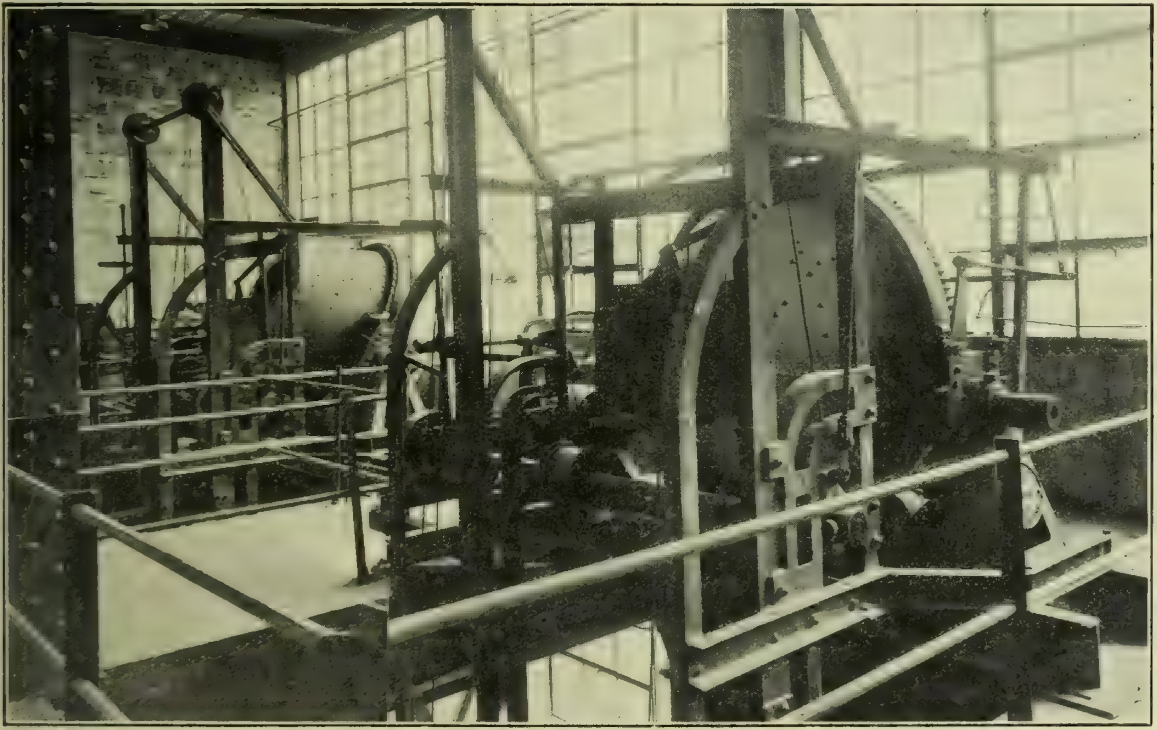


Fig. 2.

Smith Type Batch Mixers.

Separate machines used for lead and soda-lime glasses.

Gas is supplied by a Morgan gas machine. This is housed outside the main building, being immediately behind the elevator shown in Fig. 1. This elevator serves to take the coal up to the overhead bunker placed above the gas producer. The coal arrives in wagons and can be either dumped into an underground bin from which it passes to the boot of the elevator just mentioned, or, by means of a mechanically operated "scraper," it can be discharged from the wagonsand put on to the stock pile. The same mechanical scraper also serves for bringing the coal from the pile to the elevator, when it is desired to work from stock.

In the foreground of Fig. 1 will be noticed a cooling tower. All the circulating and cooling water used in

With the tank as first constructed, there was a considerable quantity of unburnt gas passing through the tank and into the chambers the other side, so that the British Thomson-Houston Co.'s staff decided that they would alter the port design and make them wider and shallower, whilst still maintaining the same total area. This resulted in a blanket of flame being spread over the metal, the tank gave more even and regular operating results and, more important still, there was a reduction of approximately 25% in the fuel consumption for the same output of metal.

The batch is fed into the tank through the dog-house, and it should be mentioned here that it is absolutely essential to maintain the metal level within very close limits for successful operation of the Westlake bulb machine.

To enable this to be done an extremely simple yet effective device has been installed, which consists of a small refractory float in a gathering boot at the working end of the tank. Resting on this float is one end of a pivoted lever, the pivot and other end being outside the tank. A lighted electric lamp is fastened at this end; it therefore follows that, the arms of the lever being equal length, any downward movement of the float causes a corresponding upward movement of the lamp. Immediately in front of the lamp is fixed a lens which throws an image of one part of the lamp filament on to a wall some distance away, the lens and distance being so arranged in this instance that the movement of the filament is magnified 100 times on the wall. This image is in view of both the man at the dog-house and also the machine operator. The latter is therefore able to keep a close check on the former. The man in charge of the filling has also the gas producer to attend to, as well as the periodic reversals of the gas and air valves.

We now come to the bulb making machine, which, as just mentioned, is of the Westlake type. Twenty-four moulds are carried so that each revolution of the machine means 24 bulbs. For the ordinary size and type the machine has an output of about 55,000 good bulbs per day of 24 hours.

The Westlake machine is probably more intricate and fascinating to watch than machines used in any other branch of glass manufacture. The general principles of its operation resemble closely those of the Owens machine for the production of bottles, i.e., the requisite amount of glass is gathered from the furnace by suction in a blank or parison mould; the parison is then indented by a plunger to form a small initial cavity into which compressed air may be admitted to blow the bulb to its final shape when the parison has been transferred to the finishing mould.

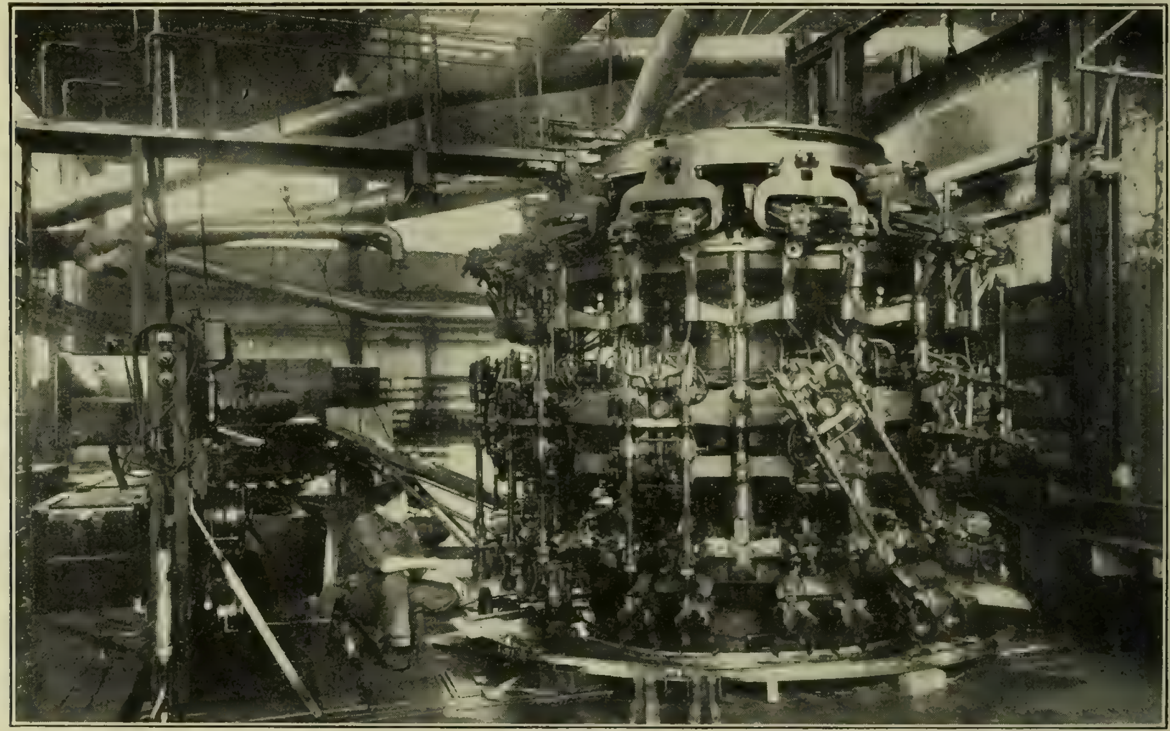


Fig. 3.

View of Westlake Machine.

This photograph shows the blowing arms which transfer the glass from the parison to the blowing moulds at various stages of the transferring process.

There is also some similarity between the general appearance of the Westlake and Owens machines in that the arms or heads carrying the moulds radiate from and rotate about a central column, the timing and operation of the various movements being effected by means of cams, rollers, etc. Figs. 3 and 4 will give an impression of the appearance of the machine at Chesterfield.

In order to facilitate and simplify the description of the operation of the machine, it will be best to follow the progress of one head during the manufacture of a bulb.

As previously mentioned this machine carries 24 finishing moulds, but they are mounted in pairs, there being only 12 heads, although each mould forms part of a separate productive unit and can be adjusted in many respects entirely independently of the other 23.

The blank or parison moulds are mounted near the top of the machine, and at the end of arms which are set at an inclination with the horizontal. As the machine rotates (in a clockwise direction) and the arms approach the working opening in the furnace, they move outwards and, due to the inclination just mentioned, the moulds eventually come in contact with the surface of the molten glass in the gathering boot. At this moment the vacuum valves open and a charge of molten glass is sucked into each mould. The arms then commence to be withdrawn, the surplus metal at the bottom of the mould being severed by means of oscillating knives mounted on each mould arm. The arms are then completely withdrawn, the time taken to perform the entire gathering operation being approximately a second and a half.

The blank moulds, with their charge of glass, are then immediately above two vertical arms, at the upper ends of which are mounted what may be termed the neck rings or moulds, to which the glass is then transferred by the opening of the parison moulds and the release of the vacuum. These vertical arms can be rotated about their own longitudinal axis and also can be rotated through 180° about a pivot or trunnion fixed approximately half way up the machine in such a position that, after making this movement of 180°, the embryo bulbs are brought exactly into position for the finishing moulds to close around them. The arms are also hollow, and carry the plunger for indenting the parison, which operation occurs immediately the glass is delivered to the neck moulds and before the arms begin to turn.

After indenting, the plunger is withdrawn and a puff of air admitted to the cavity it has formed, at the same time the arms commence to rotate about their own axis and also turn about the central trunnion. In Fig. 3 a pair of arms will be seen which have partially completed this turning operation. When this is finished the hollow parisons are hanging vertically and are allowed to stretch a little, due to their own weight, after which the finishing moulds close round them, compressed air is again admitted and the bulb blown to shape.

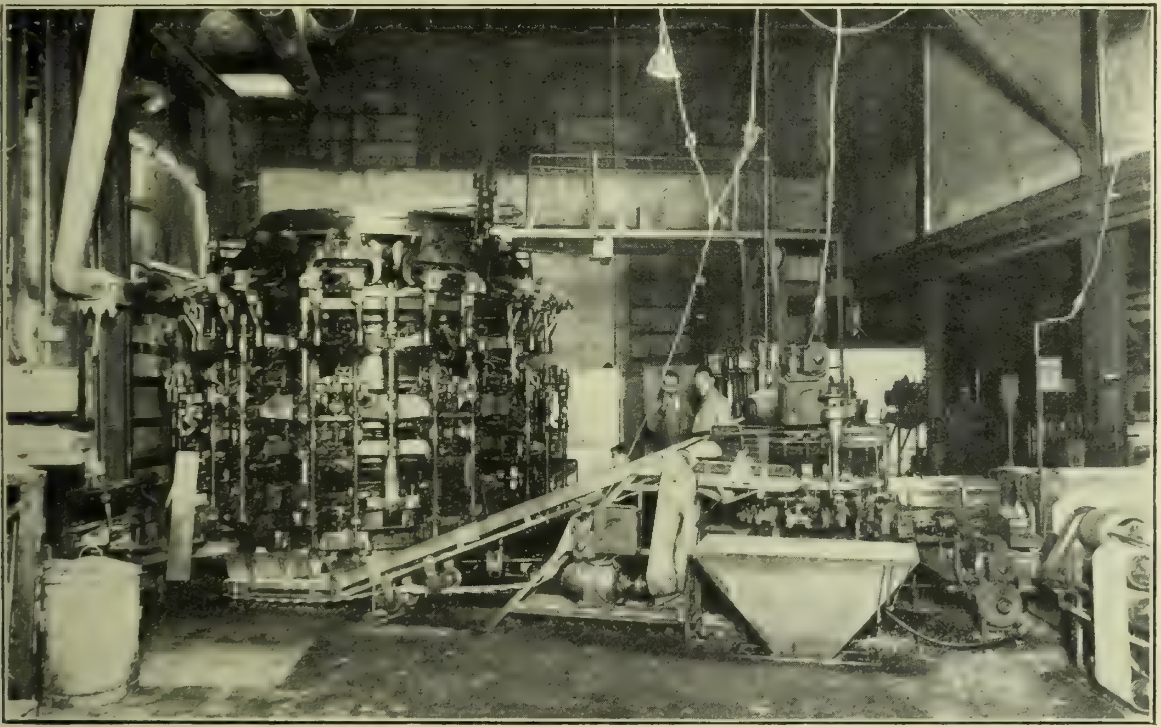


Fig. 4.

View of Westlake Machine, Burning Off Machine, etc.

This is the opposite side to that shown in Fig. 3 and shows point of delivery of the bulbs, also conveyor to "burning off" machine, entrance to lehr and one end of the 3 tier cooling conveyor.

Of course, the machine has been slowly rotating whilst these operations are being performed, so that finally the finishing moulds and the blown bulbs arrive at the point in front of the small conveyor shown in Fig. 4, where two blown bulbs can be seen suspended from the neck rings. The finishing moulds and neck rings then open and the bulbs are delivered on to the conveyor to be carried to the burning off machine shown to the right of Fig. 4. Pasted moulds are used as finishers, and after the bulbs are discharged these moulds are automatically dipped into a water trough to be ready to receive the next parison.

The machine is driven by a 6.5 h.p. electric motor, separate motors being provided for raising and lowering the machine, and also for moving the machine to and from the furnace, these each being 5 h.p.

The motor control gear is somewhat elaborate to take care of the extremely fine regulation required with these operations. In order to prevent damage to the machine in the event of arms or moulds sticking and thus coming in contact with the furnace structure, etc., etc., special overload trips are fitted, safety gates being provided, one of which can be seen on the extreme left of the machine in Fig. 4, to protect the operators; if this gate is displaced, current is immediately cut off the driving motor and the machine rapidly brought to rest.

Like the majority of other glass forming machines, there is an elaborate system of air ducts and pipes for cooling, and an interesting feature of the British Thomson-Houston Co.'s installation is the fact that all the air used on the machine for this purpose, is filtered at the inlet to the fan. This filter means little, if any, increase in the power required to operate the fan, but results in all the cooling passages being kept clean and free from risk of obstruction.

On being delivered from the machine the bulb is still attached to the cap or ring of glass by which it was held by the blowing arms, and this has to be removed by the "burning-off" machine shown to the right of Fig. 4. The bulbs are carried up the inclined conveyor which consists of an asbestos belt and delivered toa rotating star wheel, the speed at which the openings pass being somewhat greater than the rate at which the bulbs arrive, in order to avoid congestion and breakage at this point.

From the star wheel the bulbs are delivered to revolving holders on the "burning-off" machine, and whilst being rotated are subjected to the heating action of a series of small high pressure gas jets which impinge on the glass at the point where the cap is to be severed. The effect of these jets is to melt the glass at that point, the cap falling off into a cullet bin. One advantage of burning off instead of diamond cutting is that the edge is rounded and smooth as distinct from being sharp. The de-capped bulbs are then transferred to the lehr for annealing, the entrance to which can be seen to the right of Fig. 4.

This lehr is of the open tunnel type fired with town's gas and is 22′ 0″ long and 13″ wide inside. The bulbs take an average of 1½ minutes to pass through, and during that time are first raised to approximately 500° C., and then cooled to approximately 300° C. They are then delivered to a belt conveyor, which finally delivers them to a 3-tier cooling conveyor and then to the sorting table. The discharge end of the lehr and this cooling conveyor

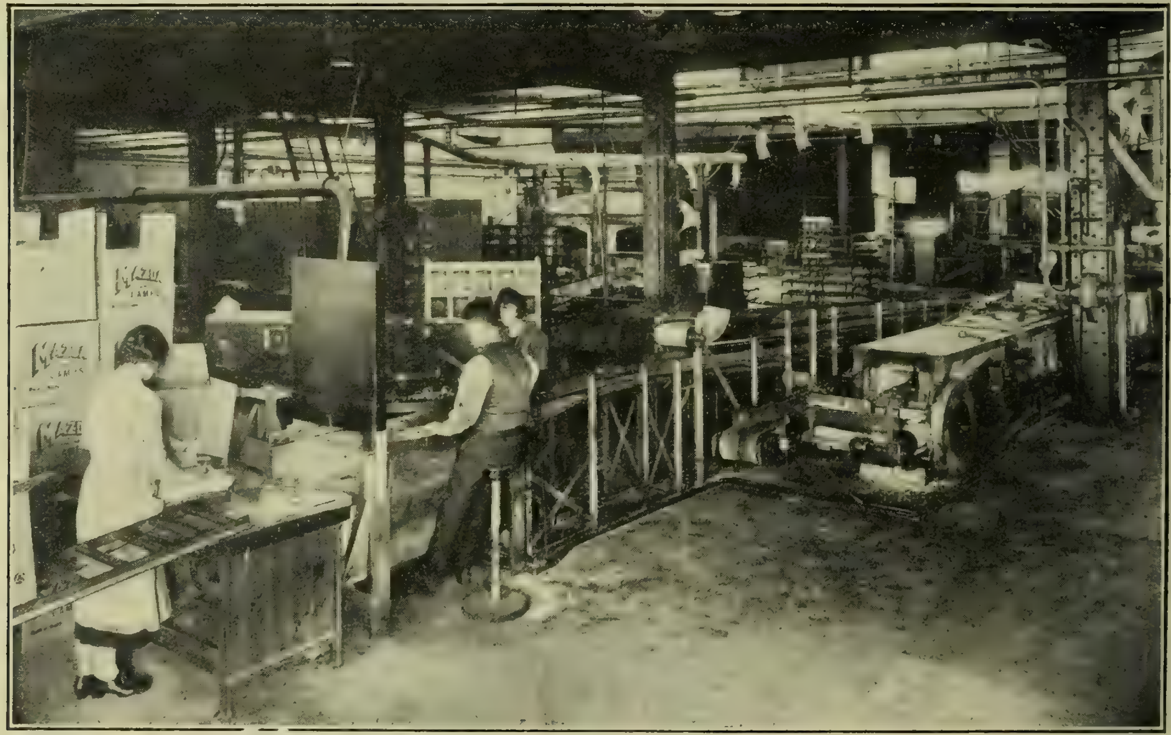


Fig. 5.

View showing cold end of lehr, cooling conveyor, sorting table, and one girl packer Note the 10 compartment box for classifying defects, in centre of photograph.

and sorting table are clearly shown in Fig. 5. The sorters are provided with a Hilger strain-viewer and also a very simple but effective device for showing up "cords" etc., in the bulbs.

This is simply a metal box with a ground glass front across which are painted blue lines about ½″ wide and ¾″ apart. Inside the box is an electric lamp and when these lines are viewed through the bulb, the presence of cords or striæ is immediately detected.

The sorters are also provided with a circular table about 3′ 6″ diameter, which can be rotated by hand. Preliminarily rejected and doubtful bulbs are placed on this table and then submitted to a second inspection before final rejection, in which case a tally is kept of the defects by means of a frame with 10 pigeon holes, seen behind the girl sorter on Fig. 5. Each hole is for a specified defect and is fitted with a small counter. In this way the total rejects are analysed every hour, thus enabling any persistent fault to be traced and remedied without delay.

In addition, a continuous check is kept upon the variation in wall thickness and also the shape and angle of the bulbs, etc., several unique devices having been developed by the works staff for this purpose.

After being accepted and passed, the bulbs then go forward to the packers, who put them into the well known fibre boxes which, by means of a gravity runway, are delivered to the floor below and out to the loading bay to be placed in railway vans or lorries for despatch to the lamp factory at Rugby.

It will, of course, be obvious that, in order to obtain efficient and economic production from an equipment of this nature, comparatively long runs on the same size bulb are necessary. Consequently, in order to deal with those sizes and types, the quantities required of which do not possess this qualification, two shops of hand workers are employed.

These work one on either side of the tank, Fig. 6, showing one blower using a "mechanical boy." This is simply a pedal-operated device which, after each bulb is blown, lowers the pasted mould into water and then raises it again for the next blowing. Incidentally, on the right of this photograph will be noticed one of the illuminated glass screens with the lines on for the detection of cords. In passing, it might be mentioned that these large bulbs are not annealed before despatch. The smaller hand made bulbs are annealed in a small, town's gas fired, lehr approximately 10′ feet long and 11″ wide. They are put in cold, in trays, and gradually raised in temperature, and then cooled, the time taken being about 15 minutes, the lehr belt being driven by a ¼ h.p. motor.

The burner equipment fitted to this lehr is of the "surface combustion" patented type as manufactured and supplied by Messrs. British Furnaces, Limited, Derby Road, Chesterfield. This equipment has many

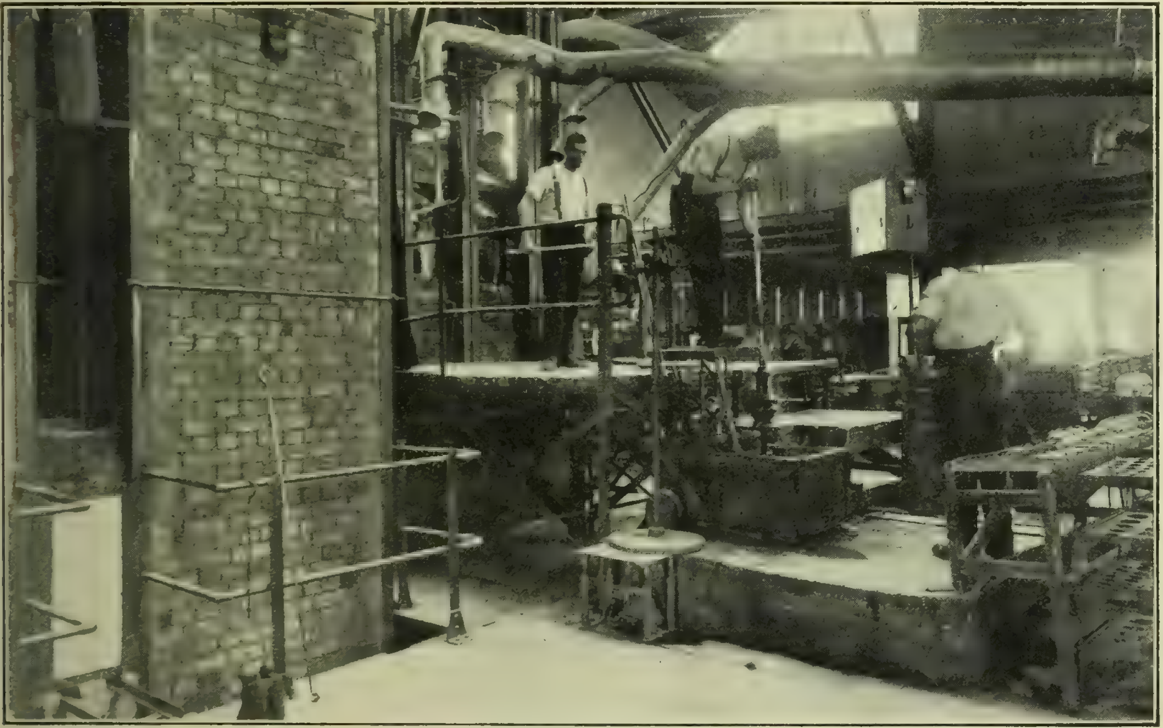


Fig. 6.

View Showing Hand Blower Using "Mechanical Boy."

The ground glass screen with lines for detecting "cords" can be seen to the right. On extreme left will be noticed the mould furnace between the ports of the furnace.

distinctive features amongst which are: automatic proportioning of the air-gas mixture, single valve control, positive control of temperature and furnace atmosphere.

The burner consists of a heavy cast iron body set in the furnace wall and having only a minimum surface of metal exposed to the heat of the furnace. Any heat absorbed by the burner tip is conducted back to the outside of the furnace and dissipated to the atmosphere by means of cooling fins. Beyond the burner, but still in the wall of the furnace, a tunnel is formed of infusible cement and combustion of the air-gas mixture takes place in this tunnel.

The burner is supplied with a correctly proportioned and thoroughly homogeneous mixture of gas and air through a patent "surface combustion" proportioning inspirator which automatically maintains constant and correct proportions of gas and air in the mixture supplied to the burner, irrespective of the rate of consumption and without any attention on the part of the operator.

Independent means are provided for setting the air gas ratio and any desired furnace atmosphere can be obtained from highly oxidising to highly reducing. The amount of mixture consumed is controlled by manipulation of the air valve only, and a water gauge on the burner gives a reliable indication as to the rate of consumption.

Before leaving this side of the works mention should be made of the small mould heating furnace placed between the stacks of the ports of the melting furnace. This can be seen in Fig. 6. and is heated entirely by conduction from the stacks. This effectively replaces a separately fired furnace previously employed, and is used for baking on the coating of boiled linseed oil and cork dust employed for "pasting" the moulds.

Glass tubing and rod enter into the manufacture of electric lamps, and consequently the British Thomson-Houston Co., Ltd., installed the necessary equipment for producing it in the same factory as the bulbs. In passing, it might be mentioned that practically all the smaller size lamp bulbs, such as those used for motor car lighting, are made direct from tubing, some very intricate little machines having been developed to perform this complete operation entirely automatically.

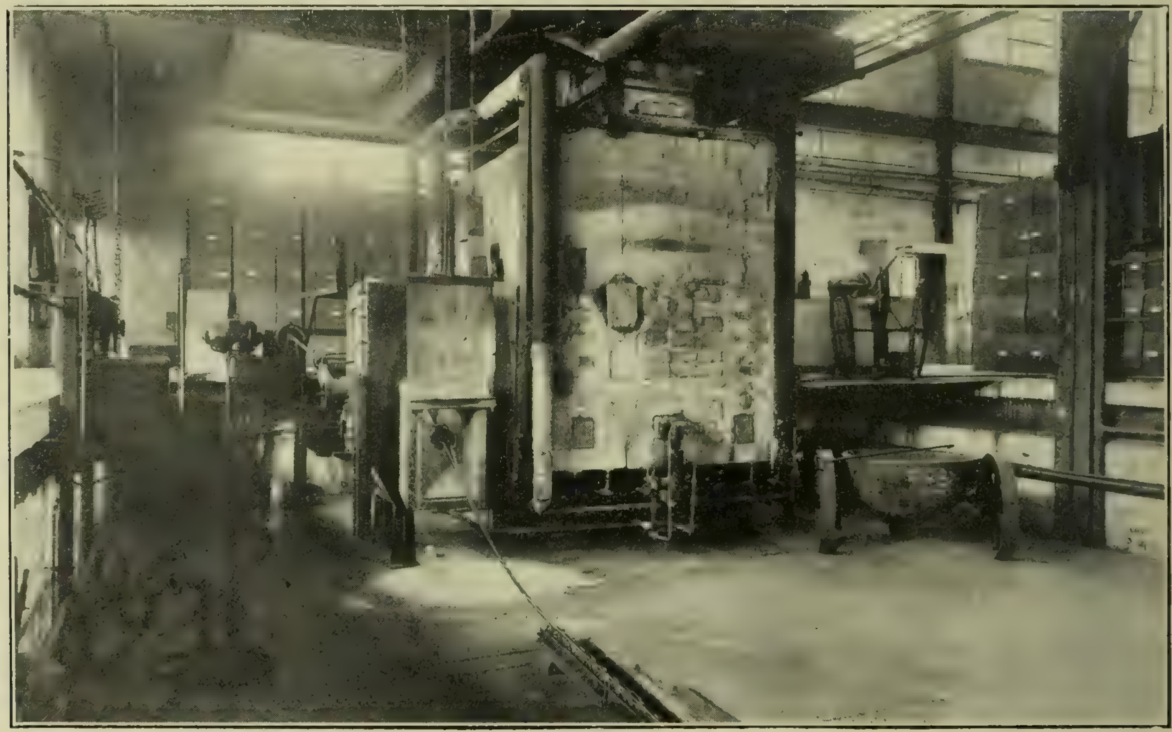


Fig. 7.

Danner Tube Machine.

View showing tube leaving the revolving mandril. The burner for heating the muffle have been removed for the purpose of taking this photograph.

Having regard to the fact that quality as well as quantity is an essential feature of the tubing required, the "Danner" tube making machine and equipment was installed. This can be divided into two parts, the first being the furnaces and tube forming device, and the second the drawing, gauging and weighing mechanism, the two sections being connected by a long "run" some 150 feet long, in which the tube is supported on a series of grooved pulleys or rollers.

The glass is melted in covered pots in an 8 pot furnace, each pot being of approximately 30 cwt. capacity.

After being melted the glass is transferred to a "working" pot which is similar in shape and size to those used for melting but is provided with a delivery slot on the side opposite to the charging opening, the slot being about 5 inches wide and 3 inches high. This working pot is placed in a separate small oil-fired furnace, in order that the glass temperature may be kept constant at that found most suitable for the particular size of tube or rod being made. The furnace can be seen in Fig. 7.

The tube forming machine itself appears remarkably simple, but to arrive at this desirable condition many difficulties had to be overcome. In principle the machine consists of a mandril placed inside a species of muffle in such a manner that its longitudinal axis is inclined to the horizontal at an angle of approximately 45 degrees. The mandril is hollow and made of a nickel chrome alloy, over which is placed a fireclay sleeve about 6″ diameter and 28″ long.

By means of suitable mechanism this mandril and sleeve can be continuously rotated, the speed varying from 5—8 revolutions per minute, dependent upon the tube being drawn, glass temperature, etc. The glass arrives on the mandril from the working pot in the form of a flat ribbon about 2″ wide, having first passed through a fireclay trough, the object and construction of which is to prevent "eddies," eliminate scum, bubbles, etc., and also give the glass the ribbon formation in which it arrives at the upper end of the mandril. The flow of glass is regulated by means of a gate which dips into the fireclay trough.

If the mandril were stationary, the molten glass would flow down to the under side of it and finally fall off at the lower end; due to its slow rotation, however, the glass is wrapped round the mandril, although still maintaining a steady flow towards the lower end. Air at a pressure of about 1″ w.g. is admitted through the hole in the centre of the mandril, being applied to the upper end outside the muffle. This pressure is just sufficient to prevent the opening in the lower end being closed by the glass, which thus flows off with a hole through its centre.

The purpose of the other portion of the equipment is to provide the necessary means of removing this embryo tubing at the same rate as that at which it is produced, the long "run" giving the tube time to set straight, and also to cool.

The drawing mechanism end of the equipment is

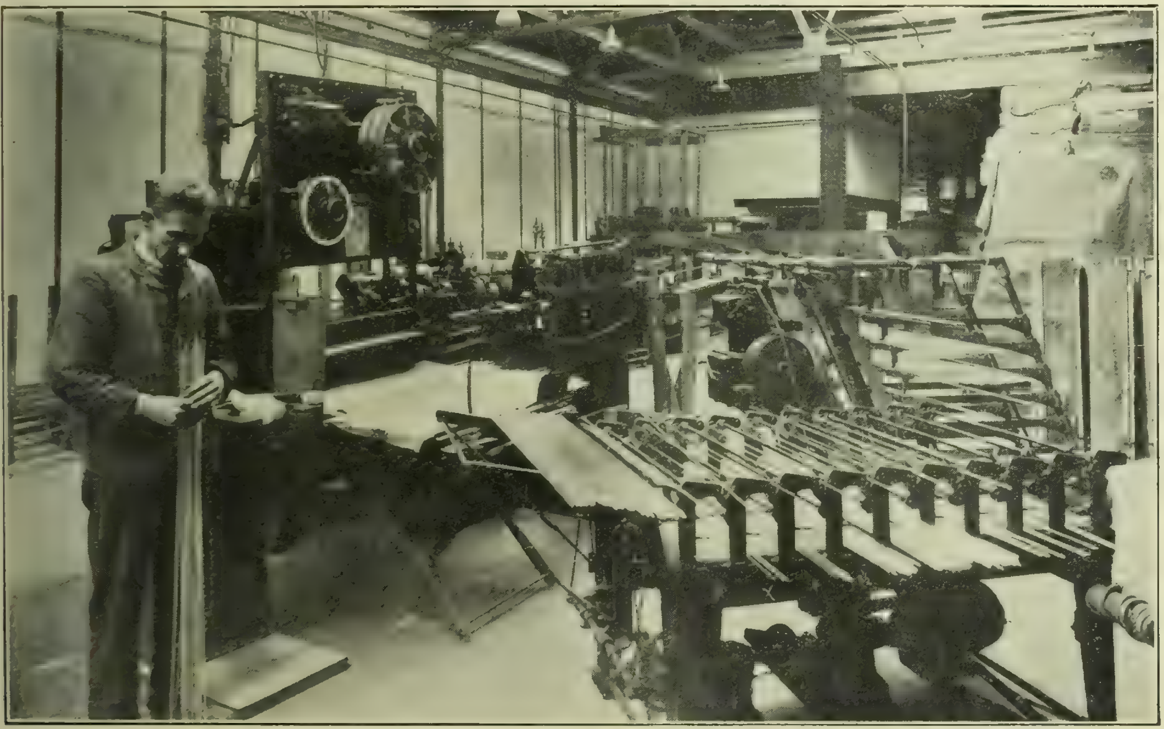


Fig. 8.

Danner Tube Machine.

This photograph shows the "drawing" end of the machine. In the lower right hand corner can be seen the gauging machine for classifying the tubes according to outside diameters. The device for classifying according to wall thickness being immediately behind.

shown in Fig. 8. Its object being to exercise a constant and uniform tractive force on the tubing, this is passed between and gripped by, a series of asbestos covered pads carried on two endless chains. These can be seen in the centre of Fig. 8. The lineal speed of these chains determines the speed at which the tube is drawn, and can be varied between fairly wide limits, but with a very fine and close regulation between these limits to suit the various sizes, wall thicknesses, etc., required.

The same machine also cuts the tube into lengths all exactly the same (about 3′ 10″). The cutting is performed by a steel disc rotating at high speed, the wheel being mounted on a carriage having a horizontal movement backwards and forwards along the tube. When travelling forward, the wheel is lowered into contact with the tube, cutting a nick; during this forward motion wheel and tube travel at exactly the same speed. After nicking in this way the tube is automatically broken off and then passes to a device which grades the cut lengths into different categories in accordance with their outside diameter. Its action is analagous to that of a screen for grading granular material but in this instance the " mesh " consists of a series of small rollers, set in pairs, the distance between each successive pair being slightly greater than that of the preceding pair. (The finer the grading that is desired, the less this difference is made. At Chesterfield, it is usually .01″ between each category.) The cut lengths of tube are placed on the feeding end and each then automatically passes over these rollers successively until, arriving at the first pair whose distance apart is wider than its outside diameter, it passes between them, falling into the compartment below. This apparatus can be seen in the front of Fig. 8. The tube is gauged at both ends at the same time, there being a set of rollers at each side of the machine.

After being classified as regards outside diameter, each tube is then again classified according to its wall thickness. This operation is also performed automatically, the principle being that if the lengths of tubes are uniform and their outside diameters the same, then their weight will vary in accordance with the thickness of the wall.

The machine, therefore, consists of six small weighing machines set one below the other, each successive one being set to trip at a slightly less weight than the one above it. After being classified according to outside diameter, the tubes are then placed on this weighing machine, one class at a time, with the result that the tubes are graded once more into sections having not more than .01″ variation in wall thickness. The various grades and sizes are then packed in special boxes for shipment to Rugby.

As can be imagined the output of an installation of this nature is of necessity high, thus, tubes having an outside diameter of 10 mm. and a wall 1 mm. thick giving an 8 mm. bore are produced at the rate of 150 feet per minute, which is equivalent to about 10,000 lbs. per 24 hours. The speed of drawing varies almost inversely as the diameter, that is to say, the smaller the tube the faster it is drawn, so that the *weight* of glass drawn per minute remains almost constant. It will be realised, however, that the successful operation depends upon the correct co-ordination of numerous conditions, such as glass temperature, speed of drawing, air pressure, etc. In passing it might be added that, by eliminating the admission of air to the hollow mandril and using a special fireclay sleeve with a closed end, it is possible to draw solid rod instead of tube.

The operating results show that what we might term the " efficiency " of the process can be maintained in the neighbourhood of 90-92 per cent., which means that 90-92 per cent. of the tube drawn, of any specific size, will be accepted as coming within the limits of weight, wall thickness, etc., for that size.

Both the Westlake bulb machine and the Danner tube machine involve the use of refractories of special shape and these, together with the pots, are made on the premises, the clay employed being a mixture of Stourbridge and Yorkshire. In the making of the pots moulds in sections are used for the domes, and this also applies to the large gathering boot for the Westlake, though in this instance the mould is in one piece. These moulds, however, are only for giving the outside form, the clay being worked in by hand as usual. A rather unique construction of bottom boards and the use of elevating trucks greatly facilitates the removal of the pots from the boards, these pots weighing approximately 25-27 cwts. each.

The works are complete with a small machine shop for executing minor repairs and maintenance (the proximity to the B.T.H. Co.'s large engineering works at Rugby rendering unnecessary the provision of more extensive facilities) and also with complete equipment for the cleaning and upkeep of moulds, plungers, etc., and we were struck with the very high internal polish and finish given to these moulds, etc., which really appeared as if they were silver plated.

The electric power is purchased from the Chesterfield Corporation, the supply being 3 phase at 6,600 volts. This is reduced to 400 volts in a small sub-station at the works, the capacity being 200 K.V.A. In some instances, such as the Westlake machine and the tube machine, however, direct current has to be supplied in order to obtain the necessary facilities for speed regulation. In consequence, a motor generator set is installed, the motor being of the synchronous type, and the generator having an output of 20 kw. at 230 volts D.C. A belt driven set is also installed as a stand-by.

The compressed air is furnished by a 6 stage centrifugal compressor at a maximum pressure of 2.75 lbs. per sq. inch.

In conclusion, we should like to express our thanks to the British Thomson-Houston Co., Ltd., for their permission to publish the foregoing notes and photographs, and also to Mr. A. E. Hill, B.Sc., their Works Manager, at Chesterfield, for his courtesy in explaining the processes.

The Use of Compressed Air—*Continued.*

By ROBERT WILSON.

Compressed Air Piping (continued).

The condition of the inner surface of the pipe has a lot to do with the friction developed by the flow of air—the smoother the surface the less the resistance to flow. This, largely, is a question of material. Pipes made from solid-drawn or lap-welded steel tubing usually can be relied upon to have a comparatively smooth and uniform surface, and are more commonly used for conveying compressed air than are cast-iron pipes. The latter, however, sometimes are preferred to the steel pipes when the pipes are buried or encased. Steel pipes are obtainable in short lengths suitable for handling conveniently, and the ends can be formed to suit the type of coupling or joint to be used.

Besides being smooth the inner surface of the pipe also should be as regular as possible, as when spaces are left between the ends of the pipe sections counter currents are set up which increase friction.

The strength of the pipes, as already stated, can be left to the experience of reputable manufacturers.

Loss Due to Leakage.

The loss of pressure during transmission is, in many cases, due more to leakage from pipe joints than to frictional resistance. Small air leaks are difficult to detect, and since they cannot be seen and, generally, are not annoying, they frequently are disregarded and seldom receive the attention they merit, having regard to the financial loss incurred by allowing them to continue. Leakages not only reduce the power resident in the air, but the power expended in compressing the air which is allowed to leak away is entirely wasted. What this waste of power amounts to is best understood by giving figures for the waste and loss due to leakage through a particular size hole when the pressure in the pipe is that common in glass works, viz., 30 lb. per sq. in.

(a) A hole $\frac{1}{8}$ inch in diameter will allow about 10.2 cubic feet of free air per minute to pass from the pipe to the atmosphere when the initial pressure in the pipe is 30 lb. per sq. in.

(b) The power required to compress 100 cubic feet of free air per minute to 30 lb. pressure is (from Table IV—page 419) 11.5 b.h.p.

(c) Therefore, leakages aggregating an area equivalent to the area of a hole $\frac{1}{8}$ inch diameter involve a continuous waste of power equivalent to 1.17 b.h.p. = a total of 168.5 horse power hours per week of 144 hours.

The extent of the financial loss will vary according to local conditions, but by assuming figures for cost of power, which are easily convertible, the figures in above example can be reduced to a money basis, in which state they are likely to be more impressive.

As the basis of the calculations, power will be assumed at the following rates :—

Steam Drive—Coal at £1 per ton.

Motor Drive—Electric current at 1 penny per B.O.T. Unit.

For the steam-driven machine the steam consumption must also be assumed. For machines lower than 100 b.h.p. and steam at 100-120 lb. per sq. in., a reasonable average would be 35 pounds of steam per hour per i.h.p. Assume also that the average evaporative capacity is 7 lb. of water for each pound of coal burned in the boiler.

Then the approximate cost per week of the leakage in above example would be :—

Steam-driven compressor–

$$\frac{168.5 \times 35}{7 \times 112} = 7.5 \text{ cwts. of coal per week}$$

= 7/6 per week with coal at £1 per ton.

Electrically-driven compressor–

$$\frac{168.5}{1.34} = 126 \text{ Board of Trade Units}$$

= 10/6 per week with electricity at 1 penny per Unit.

At either of the above rates the total per annum would be a considerable amount, and it should be noted that the example is not likely to exaggerate the conditions in the average compressed air installation as the area of a hole $\frac{1}{8}$ inch diameter is not very large when spread over numerous pipe joints, valves, connections and rubber hose. The costs of power are not, of course, relative, since they have been assumed at figures convenient for conversion. The results, however, may prove sufficiently impressive to cause many a hitherto neglected leak to be repaired.

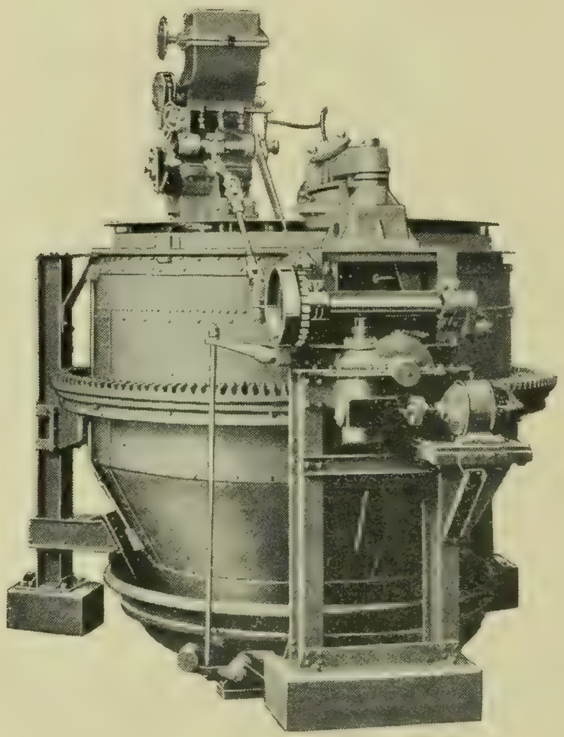
Pipe Joints.

Given reasonable provision for making good joints there should be no difficulty in maintaining the pipe "air tight." An air pipe line is not subject to great variations in temperature such as is the case with steam pipes, nor need the amount of ordinary vibration be conducive to distorting the joints. These factors assist to maintain air-tight joints, so that where leakages occur either the joint is faulty or the joint has been carelessly made.

Screwed Joint.—All joints in air mains and branches should be carefully made and discretion shown in the type of joint used. The almost universal adoption of pipes made from steel tubing has introduced to compressed air installations the ordinary form of pipe with screwed ends and with sleeve coupling, but where this coupling is used without other means of ensuring tightness leaks are very common. The coupling gets distorted in the process of fitting it to the pipes and, while a "filling" of red lead or other compound may stop up the leaks past the screw, this can only be regarded as a temporary measure (although the method is rarely treated as such), with the result that the leaks soon break out afresh and go unnoticed or are neglected.

WELLMAN GAS MACHINES

The quantity and quality of the output of any plant fired with gas depends on the constant availability of a uniformly rich gas in easily regulatable amounts.



The Wellman Gas Machine alone meets this requirement because of its special mechanical features.

Automatic from non-choking coal feed to ash discharge.

Oscillating Poker ensures the generation of consistently rich gas at all outputs.

Intermittent ash pan motion prevents clinker bridging.

Lowest running costs are obtained with Wellman machines.

Every Glassworks Manager and Engineer should send for our handbook on Gas Making.

THE WELLMAN SMITH OWEN ENG. CORP., LTD.

VICTORIA STATION HOUSE, VICTORIA STREET, LONDON, S.W.1.
WORKS :: :: DARLASTON, SOUTH STAFFS.

Telephones: VICTORIA 7752-3-4. *Telegrams:* "PRINCIPIUM, SOWEST, LONDON."

The screwed sleeve coupling can be made more effective if back nuts are used on either side, and a piece of asbestos cord wedged tightly between the coupling and the nuts. (See Fig. 10.)

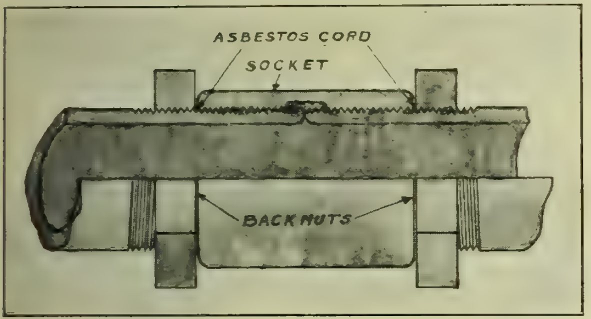


Fig. 10.

Flanged Joint.—The need to fit the coupling—or screw the pipes into the couplings—adjacent to where the pipes have to be erected, means that the pipes have to be man-handled a good deal and for this reason the largest size of screwed pipe is limited to that which can conveniently be handled in the usual lengths. This, from experience, is found to be about 4″ bore and as a rule pipes larger than this size have flanged joints.

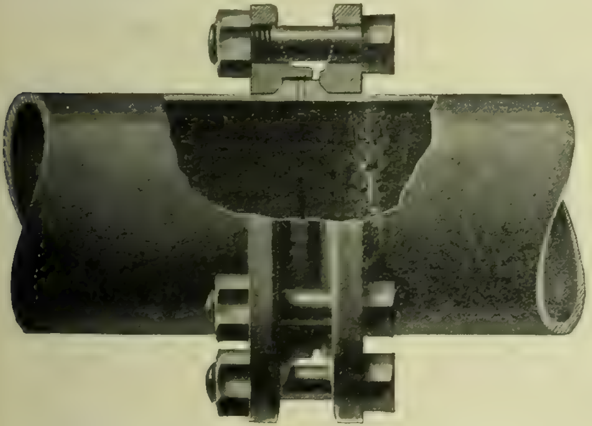


Fig. 11.

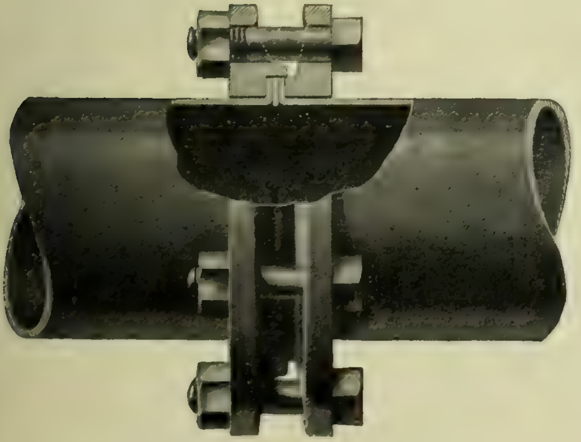


Fig. 12.

It is much easier to maintain tightness with some form of flanged joint than with screwed sleeve couplings and there is quite a variety of flanged joints from which to choose. Loose flanges are favoured in preference to the old form of fixed flanges. Two types of loose-flange joints are shown in Figs. 11 and 12. The material used for jointing should be fairly thick and of an oil-resisting nature. Many such materials are now sold in sheets from which the desired joints can be cut.

Patent Joints.—There are now several patent joints available which are an advance even on the loose-flange joint. Perhaps the best known of these is the "Victaulic" joint, an illustration of which is shown in Fig. 13. The joint is easy to assemble on the pipes and when bolted up is almost bound to be leak-tight. It also lends a certain flexibility to the pipe, which in many cases ensures that the joints are not strained by expansion, or by the pipe being forced slightly out of line. The maintenance on the joint is claimed to be infinitesimal.

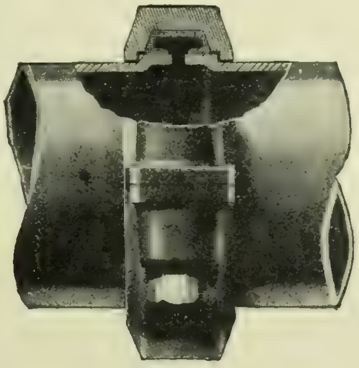


Fig. 13.

Welded Joints.—Yet another form of joint is that shown in Fig. 14. This virtually is a spigot and socket joint, but, with the spigot and socket united by means of metal welded around the edge of the socket. Leak-tightness is assured and maintenance eliminated. This form of joint is used for many long pipe ranges which are exposed to varying climatic changes, but, of course, it is equally suitable for indoor use.

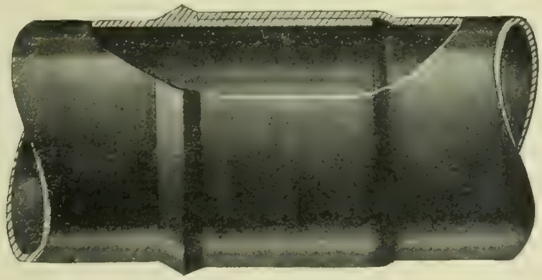
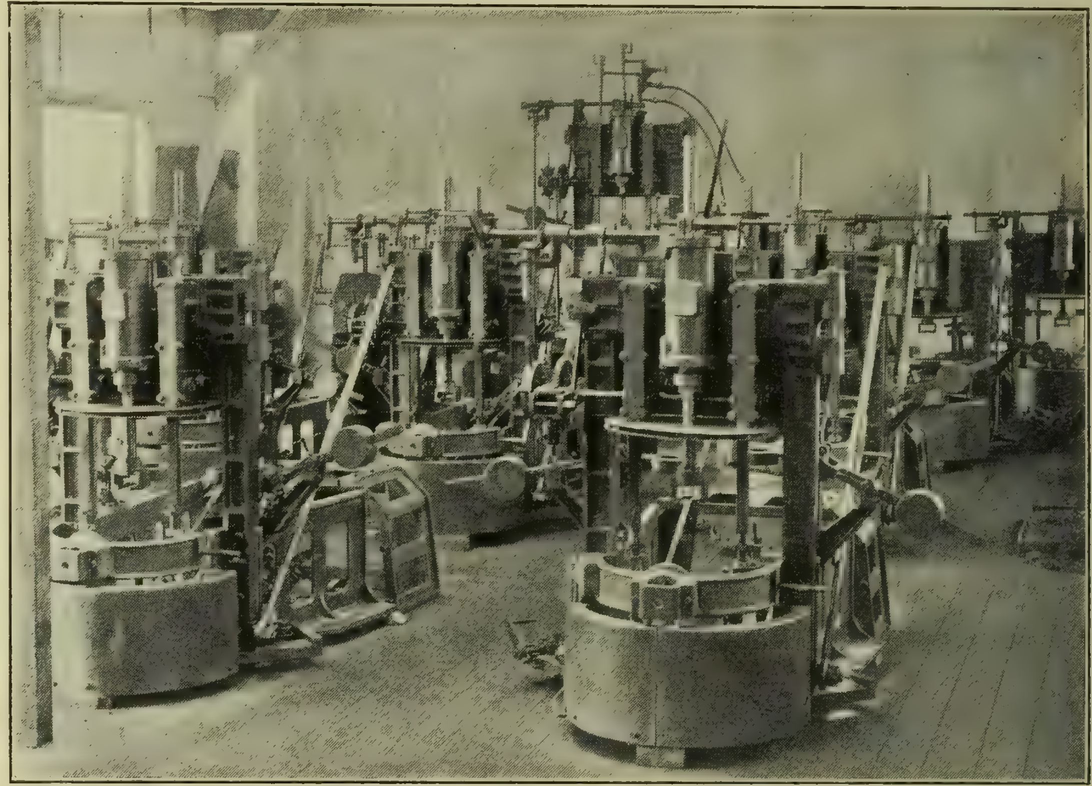


Fig. 14.

Draining of Pipes.

Even where the situation of the receiver is most favourable to the cooling of the air, the air entering the pipe still carries a certain amount of entrained moisture which continues to be deposited in the pipe so long as the temperature of the pipe is lower than the temperature of the air. The moisture is carried forward in the pipe along with the air and, unless provision is made to trap and drain it, it will pass right through to the machines and apparatus in which the air is used, often with



View of part of a consignment of "Rankin" Feeders recently despatched to Russia.

The "RANKIN" AUTOMATIC GLASS FEEDER

NOTE.

TWO NEW FEATURES.

(1).—All future installations will be supplied with our PATENTED ROTARY SLEEVE which eliminates any "cold side" in the glass and ensures perfect distribution.

(2).—We have now arranged special instalment terms whereby we instal and guarantee production in any reputable Factory, and spread payment over a period. This scheme is extremely advantageous to manufacturers as it enables increased production to be made without a large initial outlay. We shall be very glad to give full particulars of this scheme to interested manufacturers on application.

IT is acknowledged that the PATENTED SLEEVE VALVE gives the most perfect control in delivering measured weights of glass. This basic Patent is **British** in conception, and the "RANKIN" AUTOMATIC GLASS FEEDER is **British built** throughout, ensuring continuous production, long life, and the resultant maximum production.

Facts are indisputable, and the following are worthy of mention:

In England wherever "RANKIN" installations have been made unqualified success has resulted. The highest percentage of merchantable ware has been obtained, and repeat orders for Feeders constantly result.

In France we have a large and increasing number of Feeders in operation and giving excellent results.

In Germany our patents have been sold to the largest combination of glass manufacturers.

In Australia "RANKIN" FEEDERS have been adopted by the largest Combine in that country; reports of great success on all kinds of bottles are being made.

In Russia, after exhaustive investigations and visits of experts to the United States and England, the "RANKIN" FEEDER has been adopted as the best, and already a large number of Feeders have been delivered to that country.

In South Africa, Sweden, and many other countries, "RANKIN" FEEDERS are working regularly and giving unequalled results.

THE "RANKIN" AUTOMATIC GLASS FEEDER COMPANY, LTD.,

Tel. Nos.: **Holborn 0140 & 0141.** **1, Charterhouse St., London, E.C.1.** *Telegrams:* **"Natiglaso, London."**

detrimental results. It is essential, therefore, to provide efficient means of draining the pipes and of preventing the moisture getting into the machines and apparatus along with the air.

The object in all compressed air pipe ranges should be to provide dead-ends at the end of each run of piping wherein most of the moisture can be collected and drained away at intervals, and since it is easier for the moisture to follow the direction of flow, the process of draining towards the dead ends will be facilitated by sloping the pipe slightly downwards in the direction of flow. A receptacle into which the moisture can drain should be placed at each dead end, and equipped with a drain cock or connected to an automatic drain trap.

Assuming that the air main is provided with a moisture receptacle at each dead end, the branch pipes can be comparatively free of moisture if some study is given to the manner in which these pipes are taken away from the air main. The moisture deposited in the air main will naturally tend to flow along the bottom of the pipe, so that in order to avoid getting any of this moisture into the branch pipes these should be taken either from the side or from the top of the air main. If the relative sizes are close to one another, it is better to take the branch pipes from the top of the main pipe.

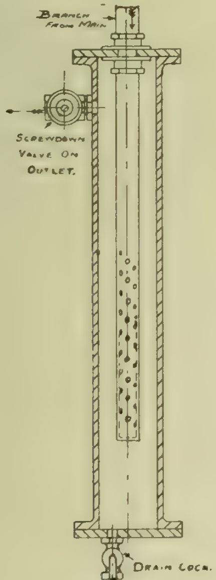


Fig. 15.

A further means of collecting any moisture deposited in the branch pipe is shown in Fig. 15. The branch pipe is led into a pipe of larger diameter, blanked off at the end, and perforated for part of the distance it projects into the larger pipe. The outlet is arranged near the top of the larger pipe and a drain cock is provided at the bottom. A water gauge glass might also be fitted. The air flowing through the branch pipe passes through the perforated holes—the combined area of which should correspond to the area of the branch pipe—and impinges on the sides of the larger pipe. The friction thus created causes slight expansion, further reduces the temperature of the air, and causes some more of the entrained moisture to be deposited. The prevailing need to bring the branch pipes close to the floor level assists the adoption of the above arrangement.

Expansion and Contraction.

In the ordinary workshop or factory, where the pipe line is inside the building and is not subject to much variation in atmospheric temperature, a few bends will easily take up the strains of the little amount of expansion and contraction which takes place. Even where the pipe range is long, and is exposed to considerable variations of atmospheric temperature, it is better practice to install a number of expansion bends rather than expansion joints, as the latter always need attention and are very liable to leak.

In erecting the piping the possibility of slight movement due to expansion and contraction should be allowed for, but the piping also should be rigid and stable so that vibration cannot be set up.

Bends and Elbows.

The air main should be free of sharp bends and elbows or tees. A radius of $3\frac{1}{2}$ diameters should be regarded as a minimum for all bends. Elbows can scarcely be avoided in the branch pipes, but there should be no excuse for them in the main, as their presence adds considerably to the friction developed by the flow of air.

Valves and Pipe Fittings.

Valves, if of the "globe" or "stop" type, are even worse than elbows for creating resistance to flow, but, as a rule, valves of this type are less prone to leak than are valves of the "sluice" or "fullway" type. The latter type is, however, more suitable for air lines, since the frictional resistance to flow is less, and, if of a solid and good make, a leak-tight condition is possible. When valves are spaced at different points in the pipe line it is very important that they should be of a reliable make, as, once in position, they cannot readily be given attention, and, should they be installed with a view to testing for leakages, any leakage through the valve would ruin such a test.

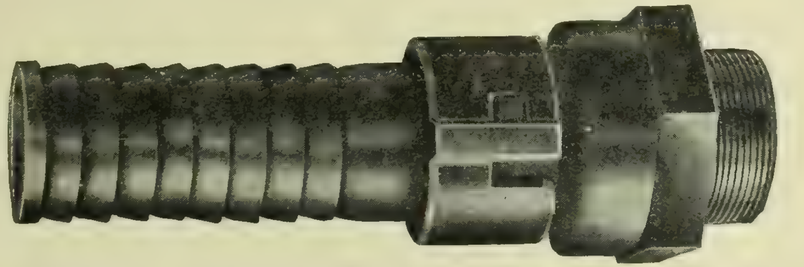


Fig. 16.

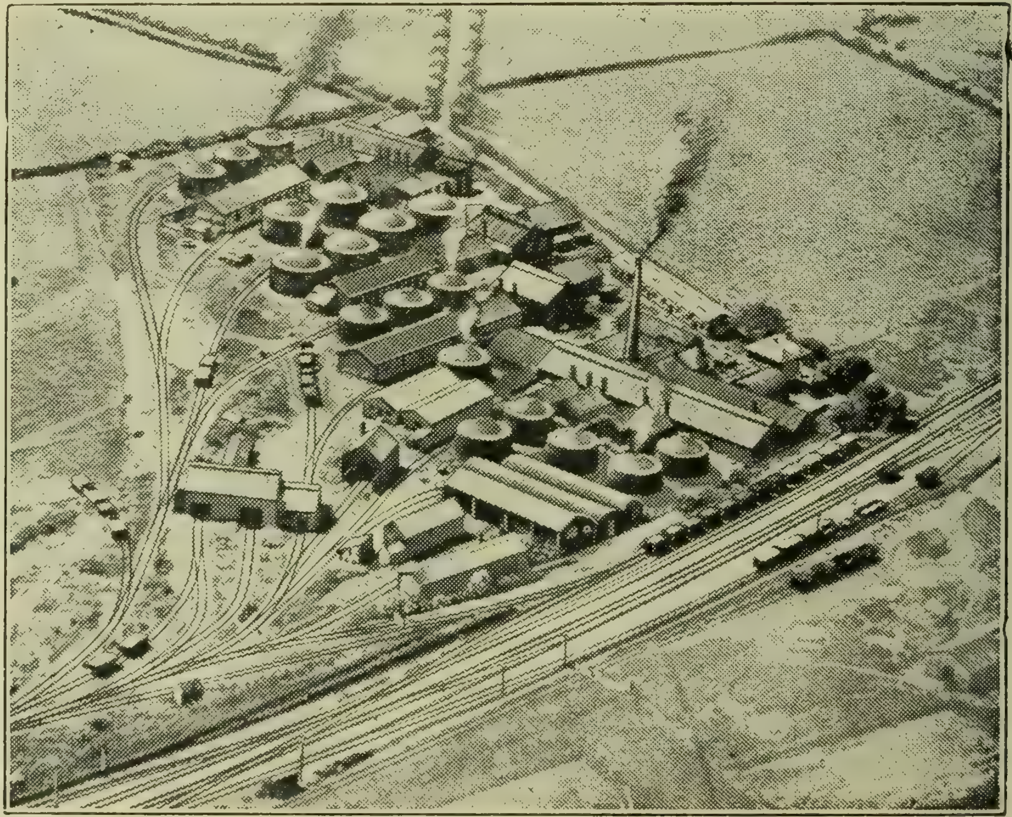
The same might be said for all pipe fittings such as drain cocks, small valves and rubber hose connections. These, too, should be the best of their kind, and the cocks and valves should be leak-tight when closed. Carelessness frequently is evident in the use and condition of rubber hose. The hose is allowed to become leaky and the connections often are badly made. Fig. 16

(*Continued on page* 557.

THE MOST DURABLE **BRICK**
MADE FOR **GLASS FURNACES.**

STEPHENS SILICA "C"

EXTREMELY REFRACTORY, TOUGH AND DURABLE.



VIEW TAKEN FROM AN AEROPLANE.

Kiln Capacity 1½ Million Bricks. Works Cover over 9 Acres.

SUPER SILICA CEMENT for setting SILICA BRICK.

Used by most of the principal GLASS WORKS.

STEPHENS & CO., KIDWELLY.

Patent Ownership Suit.

Owens' Interests Involved.

In the December, 1925, issue of this Journal, mention was made of the possibility of litigation taking place with respect to certain glass-making machines and devices emanating from the Owens Group in America. This surmise has proved to be correct, as according to the *Toledo Blade* for October 30th, a suit was filed in the United States District Court in Toledo on Friday, October 29th, by the Europaischer Verband der Flashenfabriken, a corporation organised in Germany. Reporting on the situation the *Blade* says :—

" The suit is against the Owens Bottle Co., Toledo Glass Co., Hazel O. Beesch, James C. Blair and John H. McNerney, as administrators of the estate of the late M. J. Owens, Charles J. Wilcox, James C. Blair and Charles A. Schmettau as executors of the estate of the late E. D. Libbey, the European Owens Bottle Machine Co., the Libbey Owens Sheet Glass Co.

" Millions of dollars of alleged claims are involved in the suit which charges breach of contract and asks an injunction to stop defendants from entering into competition with the German company in the territory which it alleges it is entitled to under the contract.

" The plaintiff asks also for an accounting for all damages and losses suffered by reason of the breach of contract and an order that the defendant companies be compelled to transfer and assign to the plaintiff all patents and other rights for the so-called German contract territory.

" This includes, the petition says, all countries in the world except the United States, Hawaii, Porto Rico, the Philippines, Canada, China, Manchuria, Japan and Korea.

" The suit grows out of the contract alleged to have been signed by the Toledo Glass Co. and Messrs. Owens and Libbey on November 29th, 1907, in Berlin, Germany.

" It asks also that the defendants be compelled to transfer and assign to the German company the patents and all other rights for the German contract territory to all machines, devices and processes held.

" The petition prays also that the defendants be compelled to disclose and transfer to the plaintiffs all the inventors' rights for said German territory and to account to the plaintiff for all damages and losses the plaintiff has suffered by reason of the failure to communicate and assign inventions and by reason of the defendants' exploitation of German contract territory. It also asks that the Toledo Glass Co. be enjoined from permitting others to manufacture such machinery under its patents for sale into German contract territory.

" The petition says that from April 6th, 1917, to November 11th, 1921, a state of war existed between the United States and Germany and performance of said contract was thereby suspended. During this period, the petition recites, it was arranged by and between the Toledo Glass Co., Owens Bottle Machine Co., and the Owens Bottle Co., that the last named should and it thenceforth and thereafter did, take title in its own name to all inventions made in the development department of the Owens group which had theretofore been jointly conducted.

" It ceased to remit, the petition continues, the said inventions to the Toledo Glass Co., as it had theretofore always done, and 'this was done for the purpose of avoiding the plaintiff's right to control in its territory the flow type of machine, although the basic patents relating thereto had been previously transferred to it under the terms of said agreement, and for the purpose of entering into competition with the plaintiff in the German contract territory.'

" The petition reviews organisation details of the huge glass industry that was built up here by E. D. Libbey and M. J. Owens. The Toledo Glass Co., the petition says, was organised in 1895 by Mr. Libbey, who furnished the capital to develop patents of the late M. J. Owens, who was then an employee of Mr. Libbey. This company was organised as a patent holding company, the petition says.

" Another company was organised to exploit the patents under the name of the Owens Bottle Machine Co., September 3rd, 1903, the petition recites. All of the stock of this new company was issued to the Toledo Glass Co., the petition charges, in exchange for the latter's experimental plant and American license rights on all inventions relating to the bottle making art.

" Then began the manufacture of bottle machines and the development of patents held by the Toledo Glass Co. United States patents and all foreign rights continued to be held by the Toledo Glass Co., the petition says.

" In October, 1905, there was organised under the laws of Ohio for the purpose of acquiring inventors' rights and exploiting the same, the petition says, in European countries, the Owens European Bottle Machine Co., also of the stock of which also was owned and controlled by the Toledo Glass Co., which caused its foreign rights in said invention to be set over to the Owens European Co. in exchange for all the stock.

" In 1907 the Owens European, the Toledo Glass companies, and M. J. Owens and E. D. Libbey decided to dispose of the foreign rights and entered into a contract at Berlin with the plaintiff, the petition recites. By this contract, it continues, which had for its consideration the payment of 12,000,000 marks, or $3,500,000 in American money, in installments covering a period from 1908 to 1916, the American parties transferred and assigned to plaintiff all of the inventors' rights and patents in the territory known as German contract territory.

" Briefly the petition charges that the plaintiff company carried out its part of the agreement making its

DIAMOND SAND

FROM THE

UNITED HOHENBOCKA GLASS SAND MINES

OF

H. WEICHELT & CO.

IS THE PUREST IN THE WORLD

SILICA	99.931%	MAGNESIA	0.001%
FERRIC OXIDE	0.009%	TITANIC ACID	0.006%
ALUMINA	0.037%	ALKALIS	0.010%
LIME	0.006%		

CONSISTENTLY UNIFORM.
UNVARYING GRAIN SIZE.

Makes the most Brilliant Glass and *saves* Fuel, Decolouriser, Trouble, Time and Money.

No Middlemen! We deal direct from Mines to you.

We satisfy customers all over the World.

May we quote you?

18 72
WEYSS IST DER SAND

H. WEICHELT & CO.,
8, ANTON-GRAFFSTR., DRESDEN, GERMANY.

final payment in 1916. The Toledo Glass Co., and all other interests to the contract also carried out their part of the contract up to that time, the petition says.

"The petition recites that under the terms of the contract it was entitled to all present and future inventions. It says that during the period of payment many such patents were turned over to the plaintiff.

"In the year 1916, the petition says, the Owens Bottle Co. had come into possession of the stock of a corporation called the Graham Glass Co., and certain inventions made by one Graham upon the flow type of machine. Said inventions were, however, of little importance, the petition says, until improved and developed under Owens by the Owens Bottle Co. in 1917, when it applied for patents.

"Thereafter, notwithstanding the fact that the Toledo Glass Co. had for many years previously been the owner of various inventors' rights and patents upon the said flow type of machines upon basic inventions made by Bock and others and, notwithstanding the fact that the machine of Graham while in some respects an improvement, was not a radical departure from said inventions and patents already and controlled by the Toledo Glass Co., yet the defendants took the position on November 24th, 1920, that the plaintiff was not entitled under the contract to the inventions.

"The petition charges that the defendants, to circumvent plaintiff's rights, permitted the Owens Bottle Co. to manufacture for export into German contract territory the Graham flow machines."

◆

THE USE OF COMPRESSED AIR.

(*Continued from page* 553).

shows a good type of hose connection and coupling, and, on the same principle, adaptors can be obtained for fixing to flanged connections. A screw down valve should be placed at each connection so that the air may be turned off when its use is not required. Valves spaced at different points in the pipe line in order to test different sections for possible leakages are well worth while, and, where the valve is intended for this purpose, provision also should be made for a pressure gauge.

To test a length of pipe, air at full pressure should be isolated in the section—by closing the valves at either end—and allowed to remain long enough to observe any movement of the gauge. If the gauge goes back the leak responsible should be located and repaired. Periodical tests are advisable and are less expensive than if leakage is allowed to continue.

Accessibility—Locating Leakages.

The importance of so placing the pipes as to render them easily accessible for inspection and for repairing leakages will, from the foregoing, be obvious, but even when the pipes are accessible small leakages are difficult to detect for the reason that they are not visible. A good practice for detecting leakages is to paint the joints with a soapy water solution, which, from the bubbles produced, shows where the leakages are to be found.

General.

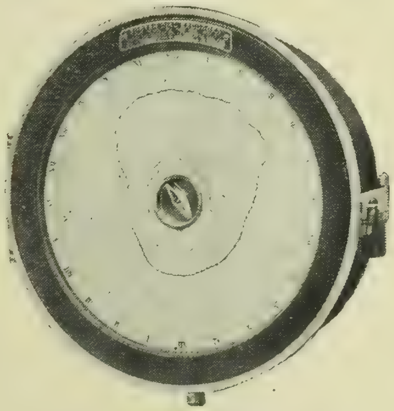
Before each section of pipe is erected it should be thoroughly scoured inside in order to remove any foreign matter which might cause obstruction and increase friction. For the same reason care should be taken that the jointing material of flanged joints does not project into the pipe. When erected the complete pipe line should be thoroughly blown out before the tools or machines are connected, as otherwise the dust and grit which is bound to accumulate in the pipes will be blown into the machines and might damage them.

Air Inlet Pipe.

It is quite exceptional to find that the air inlet on the compressor is connected by means of a pipe to a point from which cool, clean air can be drawn into the cylinder, the more common practice being to take the air directly from the engine room. If, however, the compressor can be supplied with air cooler than the air in the engine room, there will be a gain in efficiency. The gain in efficiency is approximately 2 per cent. per 10° F. reduction in the temperature of the air drawn into the machine.

A light sheet steel or galvanised iron pipe is common practice for the air inlet pipe, but some times a wooden duct is arranged. Wood has better insulating properties and ensures that the temperature of the air will remain practically constant throughout the length of the pipe.

The velocity of the air in the pipe should not exceed 1,000 feet per minute. A strainer or filter should always be fitted at the entrance to the pipe and so arranged that it can readily be cleaned.

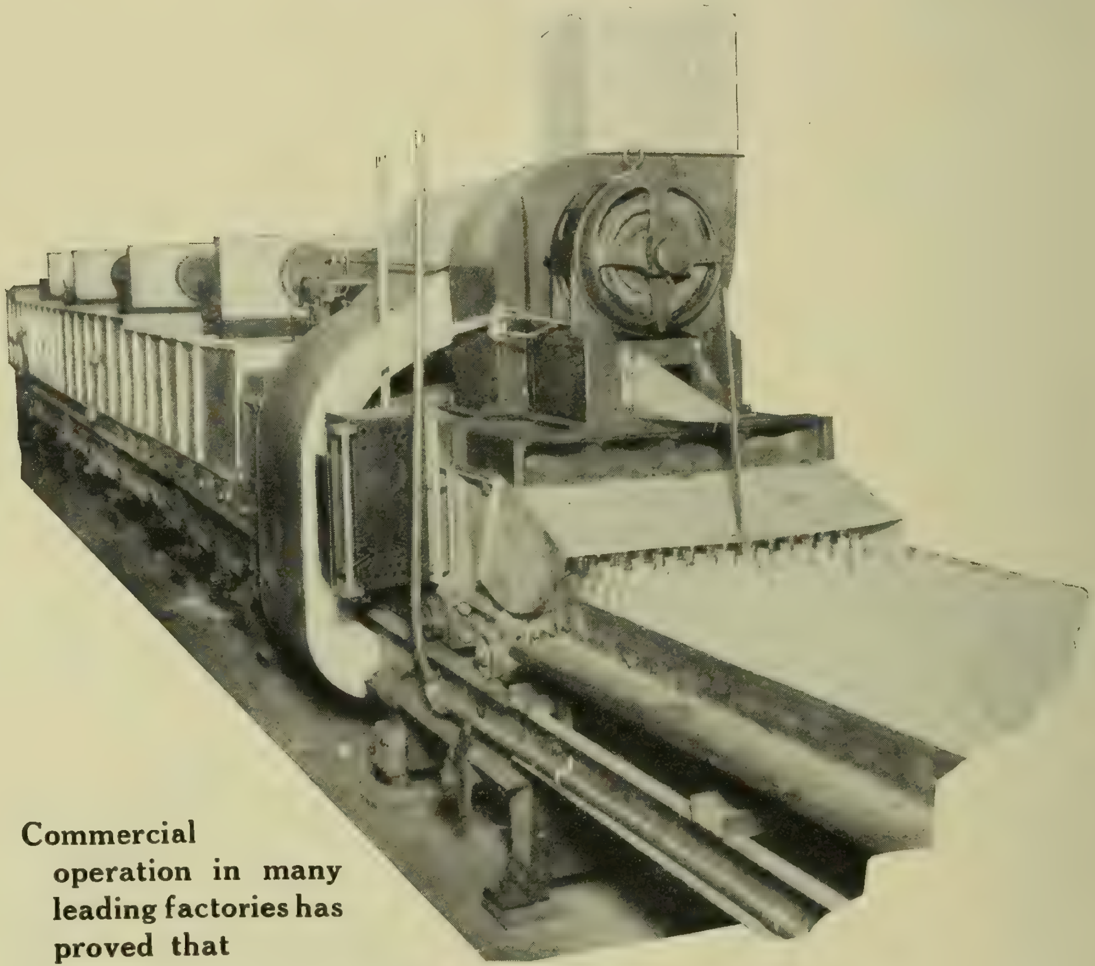
DIAL
RECORDING PYROMETER.
Simple, Robust and Inexpensive.

Full particulars in Booklet 42S.
FOSTER INSTRUMENT Co.,
LETCHWORTH, Herts. "The Pyrometer People."
Telephone: Letchworth 26. Telegrams: Resilia, Letchworth.

Another Scientific Development

THE HARTFORD LEHR

IS CREATING

A NEW STANDARD OF ANNEALING



Commercial operation in many leading factories has proved that

THE HARTFORD LEHR

1. Gives **"GRADE A" ANNEALING AT ALL TIMES.**
2. Saves FUEL (as high as 85% saving has been shown).
3. ,, WARE (No "Lehr Loss").
4. ,, LABOUR.
5. ,, SPACE.
6. ,, UPKEEP EXPENSE.

The British Hartford-Fairmont Syndicate Ltd.

142-143 Audrey House, Ely Place, London, E.C.1.

"HARTFORD" AUTOMATIC FEEDERS - FORMING MACHINES - LEHRS

The Society of Glass Technology.

TENTH ANNIVERSARY.

On Thursday, November 9th, 1916, a band of about 50 enthusiasts met in the University of Sheffield to inaugurate the Society of Glass Technology. Mr. W. F. J. Wood, C.B.E., B.Sc., F.I.C., was in the chair, and the Vice-Chancellor of the University at that time, Dr. H. A. L. Fisher, extended a very cordial welcome to the Society, which has, during its short life, more than justified the action taken ten years ago. It is small wonder, therefore, that the appeal which was issued to all members to meet in Sheffield and celebrate the tenth anniversary of the inauguration of the Society met with hearty response.

(a) Informal Dinner, Tuesday, November 16th.

An informal dinner, held in the King's Head Hotel, Sheffield, on the evening of November 16th, was attended by some forty members and friends. Sir W. H. Hadow, C.B.E., D.Mus., LL.D., Vice-Chancellor, and Mr. W. M. Gibbons, O.B.E., M.A., Registrar, of the University of Sheffield, were present as guests. When due honour had been paid to the toast of "The King," Sir Henry Hadow proposed "The Society of Glass Technology." He welcomed back Professor Turner, who had returned from America just in time for the anniversary. Sir Henry spoke of the pride which the University had in the Society. It was something of which they were justly proud, Sheffield being the only University which possessed a Department of Glass Technology. The University was at the disposal of the Society for purposes of research, and the Vice-Chancellor was confident that the co-operation between the Society and the Department would not only redound to the benefit of both, but also to the community at large.

In the course of an eloquent reply, the President, Mr. Walter Butterworth (Senior), M.A., paid tribute to the help which the Society had at all times received from the University. People who were indebted in some way to the researches which had been carried out by the Department of Glass Technology of Sheffield University were to be found wherever glass was made. Whilst expressing their gratitude to the University they also felt a personal pride in the achievements of their Society. The Journal of the Society, published quarterly, was a distinguished contribution to the literature relating to glass tcehnology.

The President rejoiced that the policy of isolation and short-sightedness which had prevailed among glass manufacturers, previous to 1916, had been superseded by a spirit of co-operation and friendliness.

Mr. Butterworth concluded his remarks by reminding those present that the gathering was of an informal character, and that he hoped members would make full use of this opportunity for friendly intercourse.

An enjoyable programme was kindly arranged by Mr. W. J. Rees. This included songs by Miss Ivy Robertson, Mr. H. A. Bateson, and Mr. W. Catchpole, and a recitation by Mr. J. H. Webster. Mr. Bateson broke any conventional "ice" which might have been felt previously by requesting all present to join in the choruses of his songs, which were selected from "Sailor Shanties." Mr. J. Connolly, Treasurer to the Society, also rose to the occasion and caused much mirth by the telling of stories from his apparently endless repertoire.

(b) Works Visit, Wednesday, November 17th.

During the morning of November 17th a large party of members and friends visited the Glass Works of the British Thomson-Houston Co., Ltd., at Chesterfield. The Manager of the Works, Mr. A. E. Hill, B.Sc., welcomed the visitors, who were conducted round the whole Works in small parties. The pot furnace and the Danner tube-drawing machine were not in operation, hence this section of the plant could be inspected thoroughly. A model of the large tank furnace for melting glass for the production of electric lamp bulbs on the Westlake machine was on view. Every effort was made by Mr. Hill and his staff to give information on, and to demonstrate the procedure adopted throughout the whole of the manufacturing processes.

After an instructive and enjoyable visit the party returned to Sheffield for luncheon, after which the business meeting of the month was held.

(c) The Ninety-Third General Meeting, November 17th.

The ninety-third meeting of the Society was held in the Department of Applied Science, of the University of Sheffield, the chair being taken by Col. S. C. Halse, Past-President. A cordial vote of thanks was accorded to the British Thomson-Houston Co., Ltd., for their courtesy in granting permission for members to visit their glass works that morning.

The Society had presented an illuminated address to the University of Sheffield on the occasion of its coming of age early in July, and this was available during the meeting for the inspection of members.

There was also on view a specimen of the Frank Wood Medal, which is awarded annually to the best student in the Department of Glass Technology, provided he attains a sufficiently high standard.

Two new members, both from the United States of America, were elected.

The Secretary, Professor Turner, announced that a cordial invitation had been received for members to attend a meeting of the Institution of Fuel Technology in London on December 7th and 8th, 1926. One paper to be presented was by Professor W. Groume Grjimailo, of Moscow University, on "Laws of Gas Flow in Furnaces."

Following the general business of the meeting, Mr. Walter Butterworth (Senior), M.A., delivered his Presidential Address. The subject chosen, "A Ten Years' Retrospect," was very apt.

TELEGRAMS:
"GLASMACHIN, ESTRAND, LONDON.
CABLES:
"GLASMACHIN, LONDON"
CODE:
BENTLEY'S.
TELEPHONE:
CENTRAL 5985.

C. SAXTON, A.M.I.E.E., M. IRON AND STEEL INST., Etc.

CONSULTING ENGINEER

Talbot House,
Arundel Street,
Strand, London, W.C.2.

BOTTLE MOULDS

ORDER YOUR MOULDS FROM

E. LUNN & Co., MOUNT STREET, GLASGOW.

Largest MAKERS of MOULDS in the UNITED KINGDOM

Quick Deliveries and Complete Satisfaction Guaranteed.

MOULDS FOR ALL TYPES OF MACHINES SUPPLIED

ALL MOULDS MADE OF CHILLED CASTINGS ONLY.

Telephone— WESTERN 2792.
Telegrams— GLASMOLD, GLASGOW.

ONE OF OUR RECENT TESTIMONIALS—

"We have one set of Ordinary Round Quart Moulds which you supplied to us which have been working for 2½ years. These are still in perfect condition, showing no cracks or any other flaw in the metal. They have been working almost continuously for the above period, only being off the machines for a week or two at a time. We have also other moulds in Square, Oval and special shapes which have been working quite as long as the Ordinary Round Quarts, although not so continuously, and these also are in perfect condition. We have always found your moulds more satisfactory than any others, and the metal you use is much more durable than any supplied by other firms."

Reference on our Testimonial File: A.B. 91.

Trade "TWENTY MULE TEAM" Mark

Granulated
BORAX
Specially refined for
ENAMELLERS AND POTTERS

BRITISH MANUFACTURE.
Guaranteed 99·50/100% pure.

Entirely free from phosphates.

BORAX CONSOLIDATED LTD.,
16, Eastcheap, LONDON, E.C.3.

TRADE NOTES.

We have received the following letter from Mr. C. J. Pratt, the Chairman of the Board of Management of the Pottery and Glass Trades Benevolent Institution.

Dear Sir,—I think you will be interested to know that, although the calls on the funds of the Institution are increasing and the need of the financial assistance from our friends becomes a matter of vital importance, the Board of Management unanimously agree that, owing to the depressed state of both the pottery and glass industries, arising from the prolonged coal strike, it will be wiser in the interest of the Institution, and, let me add, I hope considerate of the manufacturers who are our chief financial supporters to postpone the Dinner and our appeal for funds to a date in 1927—a date to be fixed when trade is once more normal.

In the meantime my colleagues and I intend to carry on, trusting only to our regular annual subscribers, and will do our best to help all those who may apply for assistance, feeling sure that when more prosperous days dawn you, in common with our other generous friends, will respond, as you always have done, to the appeal that I will then make on behalf of this Institution.

Yours faithfully,
C. J. PRATT,
Chairman, Board of Management.

This is the only Institution of its kind in the glass industry, and consequently the calls made on its funds are considerable. We should like to mention that, contrary to the impression which appears to exist in some quarters, the Institution is just as anxious to assist the employees and their dependents in the bottle and container section of the industry as in any other, and, in fact, has already done much in this direction. Consequently, we feel that manufacturers and others will recognise the claim that it has upon them. Full particulars will be willingly sent on application to Mr. J. G. W. James, 3, Dyers Buildings, Holborn, London, E.C.1.

◆ ◆ ◆

The Seventeenth Annual Exhibition of Electrical, Optical and other Physical Apparatus will be held in the Imperial College of Science and Technology, South Kensington, London, on January 4th, 5th and 6th, 1927. This Exhibition is organised by the Physical Society and Optical Society.

◆ ◆ ◆

Dr. Boris Stern, in the interests of the U.S. Department of Labour, recently visited the Ford Motor Company's glass factories. He is making a study of the relative efficiency of hand labour and machine labour in the glass industry.

◆ ◆ ◆

The Australian duty on imported window and sheet glass, which was scheduled to come into operation on October 1st, has been deferred.

◆ ◆ ◆

A private company, McNish, Ltd., has been registered with a capital of £8,000 in 7,500 10 per cent. cumulative part. preference shares of £1 each and 10,000 ordinary shares of 1s. each. The directors are A. McNish and S. H. Buckland, and it is proposed to carry on the business of manufacturers of all classes of machinery used in the manufacture of glass and glassware. The registered office is 12-13, Henrietta Street, Strand, London, W.C.2.

◆ ◆ ◆

Canning Town Glass Works has been registered with a capital of £400,002 in 10,666,720 shares of 9d. each, to adopt two agreements—one with British Glass Industries and M. D. Booth, its liquidator, and the other with the Canning Town Glass Works, Ltd., and W. B. Anderson, its liquidator.

The subscribers are G. W. Waspe, E. H. Wiseman, and five other clerks, who will appoint directors.

The amount borrowed by the directors shall not, without the sanction of a general meeting, exceed twice the nominal amount of the capital, and no charge in excess of £50,000 on any of the company's property shall be created, whether under any Debentures or Debenture stock or otherwise, without the sanction of an extraordinary resolution of the company.

◆ ◆ ◆

An unfortunate accident, resulting in the death of two workmen, recently occurred at the plate glass works of Pilkington Brothers, Ltd., St. Helen's.

The men were engaged in repairing a gas flue and were overcome by the gas. At the inquest a verdict of "death from misadventure" was returned. The men were working in the flue, two man-holes being uncovered to induce a current of air, but one of the men asked for one man-hole to be closed, and it was thought that this interfered with the ventilation, particularly along the floor. The factory inspector stated that none of the regulations had been broken.

◆ ◆ ◆

The Belgian plate glass factories are now working at 90 per cent. of capacity and prospects are excellent. In calculating the productive capacity it might be stated that this is now based on the capacity of the polishing machines. Previously the grinding machines were used as the basis but as the number of these have been doubled since the war, the capacity of the polishing machines is now the limiting factor.

Some 18 months ago it was decided to increase the number of polishing machines by one-third without any increase in the grinding equipment, and this increase is included in the present figure of 90 per cent. capacity.

◆ ◆ ◆

A new refractory for tank blocks has been developed by the Corning Glass Works. The composition for use with a lime glass, approximates to that of mullite, but the new material is melted in an electric furnace and cast into moulds, in much the same way as steel. Results obtained in use show that the new material possesses marked resistance to corrosion by molten glass.

PARKINSON & SPENCER, Ltd.

Ambler Thorn Fireclay Works,
HALIFAX, YORKSHIRE.

ESTABLISHED 1800.

Telephone : No. 1207.
Telegrams : Parkinson & Spencer, 1207 Halifax

Manufacturers of Refractory Goods of every description for the Glass industry, viz:

GLASS-HOUSE POT CLAY, FIRE CLAY, FIREBRICKS, TANK BLOCKS, BINDERS, etc.

Our Tank Blocks are unsurpassed for quality and durability.

WE SPECIALIZE IN BEST POT CLAY MATERIAL.

New Plant recently erected for the cutting and dressing of Tank Blocks to any dimensions.

FAVOUR US WITH YOUR ORDERS AND YOU WILL BE SATISFIED WITH RESULTS.

BRAND ALOSIL

SILLIMANITE BRICKS

FOR GLASS WORKS

SILICA BRICKS & REFRACTORY GOODS

PICKFORD, HOLLAND & Co. Ld.

SHEFFIELD.

Vitreous Enamel Colours.

Stains for Glass.

Oxides for Colouring Glass Metal.

Selenium Metal.

Selenate and Selenite of Soda.

GROUND BONE, FELSPAR, FLINT, FLUORSPAR, QUARTZ, STONE, WHITING, ETC.,

CARBONATE & SULPHATE of BARYTES

OXIDES OF ANTIMONY, ARSENIC, CHROME, COBALT, SMALTS, COPPER, IRON, MANGANESE, NICKEL, TIN, TITANIUM, URANIUM, ZINC, ETC.

TRADE CERAMIC MARK

WENGERS, LTD.

CERAMIC COLOURS & CHEMICALS

ETRURIA.
STOKE-ON-TRENT.
England.

Samples & Price Lists Sent on Demand.

COLOURS FOR POTTERS, GLAZED BRICK MANUFACTURERS, & GLASSMAKERS.

PREPARED ENAMELS FOR CAST & SHEET IRON, COPPER & JEWELLERY.

Limespar.

Phosphate of Lime.

Nitrate of Soda.

Nitrate of Potash.

Opavetro for Opacifying Glass.

Alumina, Oxide and Hydrate.

AUTOMATIC

NARROW NECK AND WIDE MOUTH
BOTTLE BLOWING MACHINE

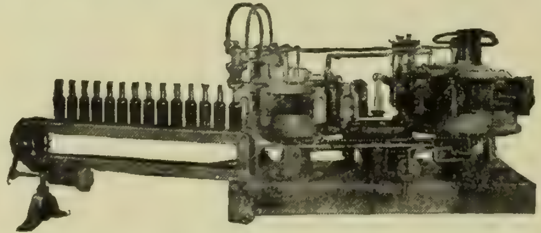
No Transfer Boy. **No Take-Out Boy.**

STRICTLY AUTOMATIC

When Operated with Mechanical Feeding Device. Can be Worked by Hand Gatherers. Speed 10 to 32 Bottles per minute, ranging in size from ¼ oz. to Gallon

LYNCH GLASS MACHINERY COMPANY,
ANDERSON, INDIANA, U.S.A.

Cable Address—"LYNCHNOBOY" ANDERSON
Codes—A.B.C. 5th EDITION, BENTLEY'S, WESTERN UNION



May be Worked on Floor Level—No Pit Needed

A Ten Years' Retrospect.

Presidential Address to the Society of Glass Technology.

By WALTER BUTTERWORTH, Senr., M.A., J.P.

As the Society of Glass Technology has just completed its tenth year, we may suitably, for a little while, look backward upon work accomplished, and forward towards new tasks.

It is well, in any enterprise, to take stock periodically and to reflect upon labours attempted, done, or left undone.

Our Society was founded November 18th, 1916, at a crucial time of national emergency and it developed with great rapidity. Remarkable foresight was employed from the beginning. To look through the published proceedings is to realise that the foundation was " well and truly laid," its probable evolution and power of usefulness foreseen ; and its possibilities of vital service to glass technology seized by the imagination, even when the founders were taking their initial steps.

Out of the ferment and difficulties of the Great War emerged our Society. At that sad time of havoc and destruction the glass industry, like many others, was called upon to undertake national services, under stress of urgent need, at shortest notice, and manufacturers had to alter their habitual methods to meet the demands of warfare.

They responded to the call with spirit and no small measure of adaptability.

Truth to say, the shortcomings of the industry were shown up in a glaring light when suddenly the sources of glass imports were cut off and our country found itself short of necessities, and ill-equipped for the exigencies of warfare as regards glass, chiefly by reason of inadequate technological study.

We had been largely dependent on foreign nations who had become enemies. The position was critical. A great effort was needed. The Government, scientists, and glass manufacturers worked together with zeal and energy, and the situation improved.

Here was the opportunity to combine forces, not only to meet a temporary crisis, but for the better organisation of the national glass industry and to base it firmly upon research and applied science.

The Sheffield University, in its admirable undertaking to establish a Department of Glass Technology, acted finely and rendered pioneer service to the country in the nick of time. It filled a gap which had never been occupied by any university in these islands ; indeed it broke fresh ground educationally (its department being still unique in any country), and it quickly added to the sum of knowledge in glass technology.

From its activities sprang our Society, which it has nurtured and encouraged ever since. The Glass Research Delegacy and the Society have co-operated, with valuable results primarily to the scientific world, and notably also in organising and assisting the whole body of glass manufacturers at home without any shadow of exclusion of fellow-workers abroad.

The projects of the Society were originally stated with concision, yet comprehensively :—

> " The general advancement of the various branches of glass technology by the association of persons interested in glass and glassware ; the reading and discussion of papers; the publication of scientific information on glass technology ; the formation of a library and museum."

Regarding the conditions of membership a very catholic invitation was issued :—

> " All persons or associations of persons interested in glass, whether from the point of view of the manufacturer, the distributor, the scientist, the user or collector, were eligible for membership."

So that people concerned in glass manufacture, directly or remotely, were invited to join forces.

The Society, through its journal, soon became the organ of the glass industry, on its scientific and technical side, and was recognised internationally as having taken a high place among scientific societies.

While research was placed in the forefront of its objects, an aim of great importance was to bring the British Glass Manufacturers into closer co-operation and better mutual understanding than before.

The alarms and anxieties of the wartime no doubt helped to draw them nearer together in sympathetic collaboration, and incidentally contributed to the growth of the society. Under the menacing war-cloud, business men were startled and shaken from routine ; patriotism entered somewhat into trade and quickened it in certain respects. Also an ideal began to take shape among the glass manufacturers for the progress and welfare of the industry and not alone for profit. It was perceived that in business also there was room for ideals.

The Society helped greatly in establishing this new orientation of ideas. Its technological work nurtures ideals, too. The investigator, absorbed in his researches, pursues some ideal. He sees with his mind's eye an ideal furnace or lehr ; an ideal machine which shall achieve things done for centuries by the labour of many hands.

Sooner or later the prosecution of such ideals, through scientific principles and technical processes, results in some addition to knowledge. And the great ideal in all such efforts of the mind is knowledge for its own sake, apart from material advantage.

The support given by the glass trade to the Society was good from the beginning and has been maintained fairly consistently through the decade.

Merely to count heads is no great matter for congratulation, but the figures as regards membership are worth quoting and yield some satisfaction.

At the end of the first year in 1917 there were 267 members and the following are the yearly numbers to the present date.

THE LONDON LEAD OXIDE Co., Ltd.

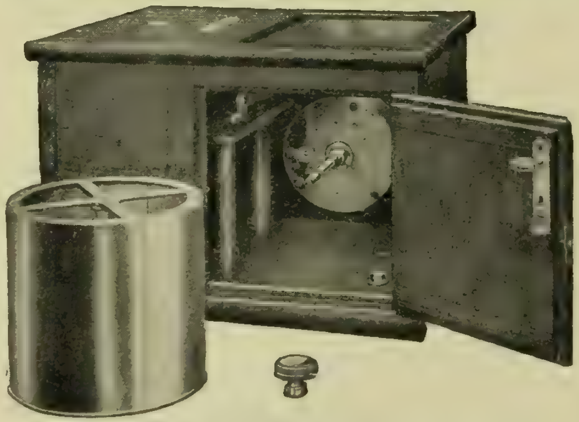
Offices : 107, Bishopsgate, LONDON, E.C.2
Telephone No. : London Wall 4527.
Tele. Address : "Londoxid, Ave, London."

Works : Royal Pier Rd., GRAVESEND, Kent.
Telephone No. : Gravesend 112.

MANUFACTURERS OF
GENUINE **ENGLISH** REFINED
GLASSMAKERS'
RED LEAD

Buyers who wish to obtain the very best material at the lowest price should write for samples and particulars.

SIEMENS
TEMPERATURE RECORDER



Drum Recorder, Type M.V.R.G.

This Recorder gives a permanent record of temperature variations on a clockwork-driven drum, which rotates once in 24 hours. No batteries are required

Further particulars and pamphlets on application.
SIEMENS BROTHERS & CO., LTD.,
WOOLWICH, S.E.18.
ESTABLISHED 1858.

SILLIMANITE

The High Temperature Resisting Refractory Material.

(*Softening Point above 1800°C.*).

Supplied ground from -10 mesh to -100 mesh. For all bricks, blocks, flue linings, siege coverings, and glasshouse pots and rings.

For the convenience of users who desire to have sillimanite ready prepared with binder, the following mixtures are also supplied dry or ready for use:—

Slip, Pot and Ring Mixtures.
(PROF. W. E. S. TURNER'S Formulæ).

Tank Block, Brick & Pot Mixtures.
(MR. W. J. REES' Formulæ).

Siege Mixture.
(GLASS RESEARCH ASSOCIATION'S Formula).
For lining the floor siege of pot furnaces and general purposes, patching, etc.

The P.B. SILLIMANITE
COMPANY, LIMITED,
Sole Agents : PAWLE AND BRELICK.
791, SALISBURY HOUSE,
LONDON WALL, LONDON, E.C.2.

Telephone Number - London Wall 4825.
Telegrams - - PLATOONS, LONDON.

It will be observed that in the last few years there has been a slight falling off in British members.

Members on Roll at end of Year.

Year.	Totals.	Honorary.	Collective.	Ordinary.	Student.
1917 ...	255	—	55	185	15
1918 ...	391	—	98	277	16
1919 ...	516	—	120	392	4
1920 ...	620	—	143	469	8
1921 ...	663	1	142	516	4
1922 ...	649	1	133	513	2
1923 ...	615	1	118	496	0
1924 ...	633	2	122	508	1
1925 ...	618	2	114	501	1
1926* ...	630	2	113	514	1

* At end of October.

C.—Location of Members on the Roll, 31st October, 1926.

Location.	Honorary.	Collective.	Ordinary.	Student.	Total.
British Isles ...	2	81	287	1	371
Argentina ...	—	0	1	—	1
Australia ...	—	3	2	—	5
Belgium ...	—	2	4	—	6
Canada ...	—	0	7	—	7
China	—	0	5	—	5
Czecho-Slovakia	—	1	3	—	4
Finland ...	—	1	0	—	1
France ...	—	4	15	—	19
Germany ...	—	3	12	—	15
Holland ...	—	3	3	—	6
Hungary ...	—	0	1	—	1
India	—	0	12	—	12
Italy	—	1	1	—	2
Japan ...	—	2	21	—	23
Norway ...	—	1	2	—	3
Peru	—	0	3	—	3
Russia ...	—	0	5	—	5
South Africa...	—	1	1	—	2
Spain ...	—	1	3	—	4
Sweden ...	—	0	4	—	4
United States of America	—	9	122	—	131
	2	113	514	1	630

The Society, almost wholly British at the start, as was natural, soon gained recognition abroad, especially in the United States, and its membership now includes firms and individuals in a score of countries; wherever, in fact, the glass industry manifests vitality.

Already in 1919 the members from foreign countries numbered about 20 per cent. of the total, and now 40 per cent. are from abroad, half of these from the U.S., the remaining 60 per cent. being British.

It may fairly be claimed that the Society is international and representative of the countries in which glass manufacture flourishes.

The relatively rapid rate of increase in foreign members, in recent years, is noticeable. While it is gratifying and helpful to have acquired so wide an international reputation, for it widens and strengthens the influences of the Society and disseminates this information wherever glass is studied, we trust that also the representation of our own country will grow apace. All are welcome, from far or near. Our doors are open wide. We place no obstacle in the way of knowledge. We wish to serve the industry as a whole. That is the appeal upon which we place the greatest emphasis. But apart from that high aim, it is worth while for every glass manufacturer to be a member in the interests of his own factory management. We invite every British glass firm to join, on both grounds, viz., to acquire the latest technical information, and to take part in furthering the progress of the industry.

From the beginning, members have included not only manufacturers, merchants, dealers, workers and students in the glass industry, but also those concerned in the production of raw materials, refractory materials, furnaces, machines, tools and all accessories to the glass trade.

This has been of great benefit to the Society in its deliberations and discussions, for expert information has been freely contributed not only in every aspect and detail of glass production, but also of the accessory and subsidiary trades.

By good fortune, or shall we say good management, a brilliant band of scientists and glass technologists have rendered notable service to the Society during its entire course.

Dr. Turner has been and remains its energising spirit. His knowledge, enthusiasm, enterprise, resourcefulness, and power of organisation have been lavished upon the work of the Society. If he is not tireless, he refuses to admit fatigue.

And he has had splendid help from colleagues of the Sheffield University, from the staff of his department and from distinguished members of the staffs of great glass and other firms in the country.

The record of their work is open to us in our ten goodly volumes of proceedings. These form a large body of valuable research work upon the manifold problems which beset the glass manufacturer who strives to keep in the van. Sometimes the problems have been solved; sometimes carried a little nearer to solution, perhaps destined to be achieved by a later investigator; in any event, technological knowledge is gradually accumulating and scientific methods are displacing the old empirical habits.

As Sir Henry Hadow remarked to us: "Scientific research is necessarily a long and sometimes a slow-moving process, but it gets there in the end."

Dr. Travers, a former President, observed:

"The glass industry presents an almost infinite field for scientific study, so vast, indeed, that it can only be touched upon in our life-time.

"Scientific and technical literature contains a vast reservoir from which fact and theory can be drawn and applied to the solution of many of our problems, and in this connection I will take the opportunity of paying tribute to the Editor of our Journal for his invaluable services to the industry in placing at our disposal a most remarkable collection of abstracts recording all important work upon glass and allied subjects."

Many Glass Manufacturers have PROVED the

MANSFIELD

CRUSHERS and GRANULATORS

to be the BEST for

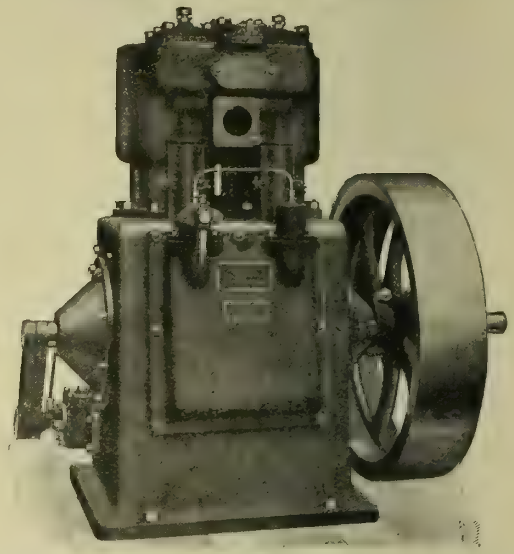
dealing with Manganese Ore, Limestone, Saltcake, Cullet, etc., etc.

Materials always remain GRANULAR irrespective of size.

FRANK MANSFIELD & CO.,
9, REDCROSS ST., LIVERPOOL.

Telegrams : PRECEDENCE, LIVERPOOL.
Telephone : 4925 BANK.

"BROOMWADE"

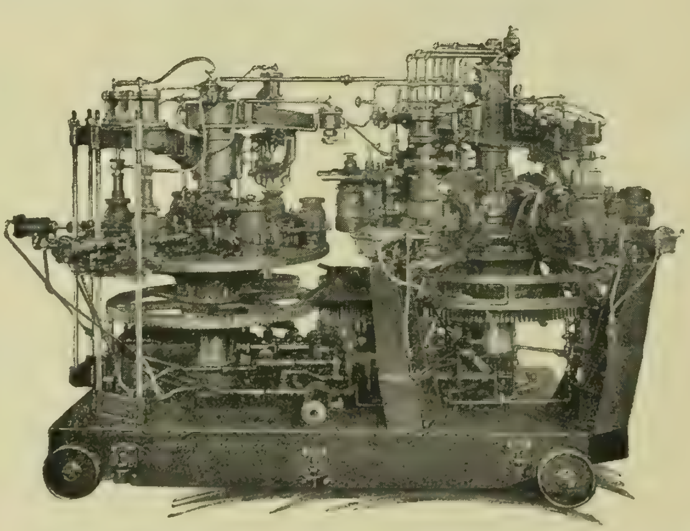


AIR COMPRESSORS

BRITISH AND BEST

FOR ALL DUTIES.

BROOM & WADE, Ltd., HIGH WYCOMBE.



The New O'Neill No. 44 Blowing Machine.

A well-built, high speed blowing machine with a range from 6 oz. to 40 oz. in capacity. Operating speeds up to 23 per minute depending on the class of ware being made. Have our London representative give you the details.

THE O'NEILL MACHINE CO.,
TOLEDO, OHIO, U.S.A.

LONDON OFFICE : 10 SAVOY ST., STRAND, LONDON, W.C.2.

Telephone : Gerrard 7190.
Telegrams and Cables : Oneillany, Rand, London.

These abstracts of technical articles in British and Foreign Journals, Patent Specifications, Reviews, etc., now number 4000. They are grouped under sections of subjects and carefully indexed. All relate to the glass and ancillary trades and now constitute a valuable reference library. The thanks of all students are due to the willing staff of abstractors, who have so devotedly placed their linguistic and scientific attainments at our service.

As befitted its name and its purpose the Society has devoted itself single-mindedly to the cause of glass technology.

Its business is to examine phenomena and deduce conclusions, with an unbiased determination to arrive at truth, or as near thereto as possible.

It has laboured equally for the welfare and advancement of every branch of the glass industry; has systematically tackled its numerous upspringing problems; has pooled and published its acquired knowledge for the general benefit.

The manufacturers therefore feel confidence in this new and powerful helper. If their old recipes and methods were good, the new knowledge confirmed them; if bad, it was plainly time to scrap them.

Perhaps, as the Society felt its way and amplified its self-appointed tasks, these might be said to fall into three categories:

1. (1) Scientific research in the field of glass technology, ramifying into industries accessory to glass manufacturing.
2. (2) The organisation of the industry of Great Britain as a great unit.
3. (3) The study of administrative and workshop methods and processes, including all details from raw materials to finished products.

In modern times the industry has changed profoundly. After many centuries, with relatively slight alterations in methods of workmanship, the developments of the last fifty years were speeded up with increasing acceleration. Those of the last 25 years have come with a rush. Mechanical inventions have replaced manual labour to such an extent that the making of bottles and containers, for instance, is now an engineering proposition.

The inventor, the chemist, the physicist had arrived.

Machinery revolutionised other branches of the industry: Sheet glass, plate glass, electric bulbs, tubing and rods soared high from hand production to mechanical mass-production.

The advent of electric lighting and of the motor-car led to great and swift developments in glass.

Special demands arose for glass to be used for technical purposes, sometimes in new industries—glass with particular properties, resistent glass, optical glass, laboratory glass, etc., produced after technological research and no longer by rule-of-thumb habits.

Ten years ago, the time was ripe, nay, it was overdue, for the establishment of a Society of Glass Technology in this country, and it appeared in response to the need.

We had rested too long satisfied with the antiquated system of isolated factories, out-worn rules and ancient usages. The quickly changing times, the new demands, called for action and radical changes in factory methods and in trade outlook. Much was to be learned and some things had to be unlearned. It began to be recognised that secrecy and industrial isolation must give way to openness, mutual aid and co-operation.

The scientific workers under the ægis of the Sheffield University happily sounded the right note.

Technical progress in the glass industry under the stimulus of technological research, and solidarity of the whole body of manufacturers.

Its department of glass technology has been the great force behind our Society. From it we derived our existence. The head of the department and its staff have laboured for its success unceasingly and unweariedly. The University has sheltered, aided and encouraged us at every turn. In reply to manufacturers' enquiries it has conducted tests and supplied 1548 replies.

In return the Society should strive, through its members and manufacturers, to render service to the University. This could take no better form than to send more students to the Glass Department, for there is the weakest link in the chain, beginning with the University student, through the classes, degree courses, and (in conjunction with the Society) research work, treatises, discussions, visits to works, intercourse of manufacturers with scientists, technologists and every class of industrial glass worker.

It is equally important to the delegacy and the industry to have a regular succession of students passing through the Department to be trained theoretically and practically for posts in the glass factories of the land.

It has been remarked that in pre-war days the glass industry wanted brains and that these were supplied by the Sheffield University and the Society of Glass Technology. Like most summary statements this exaggerates and is less than just. The industry did not lack good brains. It survived difficulties and vicissitudes, enjoyed triumphs, and achieved fine results. Let us not depreciate the men of the old school. They accomplished much in the teeth of vexatious obstacles and restrictions. They developed and maintain to this day glass craftsmanship of a high order.

But the force of tradition and fixed habits is apt to be tenacious, in office, factory and warehouse. A new spirit was needed, better attuned to the new environment. More accessibility to fresh ideas. Willingness to try fresh means and devices. A greater reliance upon research and disciplined methods of study. A more wide-awake outlook upon the trade at home and abroad. These things came, in rapidly increasing measure, in the wake of the Society of Glass Technology, publishing its investigations and discussions and garnering the observation of other countries. The meetings and conferences of manufacturers and technicians soon bore fruit. Gradually it was recognised that in place of jealous privacy we needed mutual help, co-operation, comparison of experiences and discussion of difficulties.

Here the Society introduced a healthy stimulus, for it was chiefly responsible in bringing manufacturers into frequent and friendly contact. Further it brought them into regular association with firms producing raw materials, refractories, furnaces, lehrs and machines,

SECOND EDITION.
Revised and Enlarged.

ROBERT DRALLE'S

DIE GLASFABRIKATION

(In the original German)

Edited by
DR. GUSTAV KEPPELER.

Vol. I. 778 Pages. 730 Illustrations.

Price (Bound in Linen) **65/-** post free.

J. H. Davidson, in the Journal of the Soc. of Glass Technology, says :—" This is without doubt the best and most comprehensive treatise on glass technology that has yet been published."

GLASS PUBLICATIONS, LTD.,
Talbot House, Arundel St., London, W.C.2.

Moulds

Machined to specification from finest crucible chilled castings by highly skilled craftsmen; our works equipment ensures accuracy and superiority of finish.

SPECIALITIES—

Mould equipment for **Lynch, Miller, O'Neill** and other Automatic Machines.
Glassworks Patterns, Crucible Iron Castings.

ALL ORDERS EXECUTED PROMPTLY.

Johnson Radley & Sons, Ltd.,
Chesney Works, Hunslet, LEEDS.

Telegrams—MOULDS, LEEDS. Telephone—LEEDS 21354.

TECHNICAL BOOKS.

The following are of special interest :—

A TEXTBOOK OF GLASS TECHNOLOGY.
Hodkin & Cousen. 551 pp. 251 Illustrations.
42/- net.

MODERN GAS PRODUCERS.
N. E. Rambush. 545 pp. 356 Illustrations.
55/- net.

THE FLOW OF GASES IN FURNACES.
Groume-Grjimailo. 397 pp., including Appendix on Furnace Design.
27/6 net.

OIL FUEL.
Its Supply, Composition and Application.
E. Butler. 4th Edition. 310 pp. 581 Illustrations.
12/6 net.

INDUSTRIAL FURNACES.
W. E. Trinks. Vol. 1. 2nd Edition.
22/6 net.
Vol. II. 405 pp. 292 Illustrations.
27/6 net.

THE DECIMAL PLATE AND SHEET GLASS CALCULATOR.
Samuel S. Lindsay,
Comptroller of the Pittsburgh Plate Glass Company.
29/6 net.

One large glass company estimate they are saving £600 a year in one department by the use of this book.

ANY Technical Book can be obtained from—

GLASS PUBLICATIONS, LTD.,
Talbot House Arundel Street,
Strand, LONDON, W.C.2.
Telephone : Central 5985.

chemical ingredients, in fact the entire needs of the glass industry. It tabled practical problems for discussion. It conducted experiments, carried out tests and read papers thereon, also for discussion, in collaboration with the University Department. It induced manufacturers to visit each other's works. It arranged tours abroad and visits to glass works in the United States, France and Belgium. It invited our fellow-manufacturers in those countries to pay return visits to our English works and to join in friendly conference.

Much remains yet to be done in the way of such intercourse. Not all the manufacturers have fully maintained that faith in the openness and co-operation which gained ground during the War. It is a pity. If untrammeled intercourse and mutual aid were serviceable during the War, why not in peace-time? In our ancient and interesting trade there are many problems to face, and by combined effort we shall surmount them better and more swiftly than by mutual suspicion or dogged conservatism.

The visit to the United States helped to confirm this and provided a contrast to the gloom in which some of our manufacturers like to wrap themselves. In the States self-confidence was paramount. It is a good quality when not indulged to excess. Resilience of spirit is a jumping-off board and gives us a vigorous start. Hopefulness and buoyancy keep us going. There is no use in grumbling and looking on the dark side of things.

A doleful countenance, grousing and pessimistic language breed maggots in the brain, and are helpful to no single mortal. They may set a business on the down-grade. Cheerfulness, not depression, is the watchword for a business man. Indeed, for all men.

If I touch personal reminiscences for a moment you will pardon me.

When I entered the glass trade I found that our quarter of the town was rather remarkable for an important group of seven or eight flint glass factories, some of which had recently given up and others were struggling against difficulties. One after another expired and the dwindling continued until now only one of them remains. It is a mournful record, during my own life-time, and in that very flint glass trade which, as a former President rightly said, " held a position which had not been excelled by any other country." He thought that pride of craftsmanship in this branch of the industry " had caused the British workman to discount the use of machinery." From personal experience I know this to be the case.

The prejudice led to limitation of output, discouragement and calamity in the glass trade, for a generation.

It seems to me that the causes of the decline above described were shortly : Lack of confidence and hopefulness ; distrust of mechanical inventions ; absence of enterprise ; ill-judged trade union restrictions ; ignorance of scientific research and a dogged opposition to " new-fangled ways."

On the whole, the Society has wisely kept clear of politics. Now and again a speaker may have slipped into allusions to tariffs and protection ; or let off a little steam in his indignation against some government or other. It has usually been on a social occasion, I think.

Meantime our scientists and technologists have steadily and uninterruptedly pursued their way. They have gone on with their investigations into phenomena touching the production of glass. They have followed the light of knowledge and added to the volume of things tested and proved.

When the Society published its first quarterly there was a dearth of technical literature on glass, especially in the English language. It set about vigorously to supply this want. Year by year it has published its proceedings, its papers and discussions, with specifications of patents and abstracts of articles concerning glass in British and foreign journals. Indubitably, the publication of these scientific and technical investigations has given us, for ready reference, the most important addition to the knowledge of glass technology, in the last decade, in any country. And it has largely superseded what had been written previously. The Society also published a useful Directory of the British Glass Industry, a pioneer work, and formed a reference library of *over* 500 volumes dealing with glass.

Technological research is the primary function of the Society, as its name implies ; and it is the best assurance for the prosperity of the glass industry to depend upon advancement of knowledge, rather than political expedients.

We have progressed far in these ten years, and we shall go much further if we persevere with better equipment through scientific research, joined with elimination of waste, better organisation and concentration, and the ready adoption of improvements.

Dr. E. F. Armstrong, F.R.S., President of the Society of Chemical Industry, said two years ago :

" There was one point on which he knew that he would be on safe ground, and that would be in stating what was current gossip in scientific circles, namely, that of all the specialised societies which had been formed during the last twenty years, the Society of Glass Technology was known as the most energetic, the most enterprising, the most thorough, and he hoped he might also add, the most prosperous."

It was in a post-prandial speech and perhaps something must be allowed for the glow of friendly feeling and reciprocity of goodwill between host and guest, but I believe this handsome praise did not go beyond the facts, or the deserts of those who have guided and controlled the Society.

It has done much to rehabilitate those sections of the glass industry which were at a low ebb in pre-war days, and to unite manufacturers in a common bond. This service was fairly and modestly stated recently in the *Glass Review* : –

" It has come about that during the past ten years the glass industry has acquired some sense of unity and of its own importance to the community at large. Yet we are far from having achieved that general measure of co-operation which is necessary before the glass industry can be reckoned as amongst the important industries of our country, and make its opinions authoritatively recognised."

That is a point of importance ; much work is cut out for the Society and the industry as a whole to enable it to take a high and powerful place among the industries of the country.

Although I deprecate any meddling with party politics by the Society, there are ways other than political of drawing attention to the significance and importance of our national glass industry. It has enjoyed less than its fair share of publicity. It has not hitherto spoken with a united voice. Nor has it combined its forces in any great movement such as a convention of all the sections of glass manufacture and trade, with the accessory trades conjoined.

The Society with its usual alertness has recently mooted such a project and is only holding its hand until the present strike difficulties pass. The idea is to associate with a great convention in London the organisation of a fully representative glass exhibition. The two projects together, embracing every phase of glass manufacture, scientific, technological, industrial and artistic, should give an impetus to the industry. Allied bodies such as the Optical Association, the Society of Chemical Industry, the Glaziers' Company, the British Society of Master Glass Painters, the Glass Sellers Company, the Spectacle Makers Company will be invited to confer and co-operate with us.

With goodwill and support from the entire industry we shall, I trust, have a striking and far-reaching manifestation of the almost innumerable applications of glass, and its uses in nearly every phase of daily life.

It will draw attention to and stimulate our trade and give publicity to it in the most legitimate way—by statement and exposition of accomplished facts.

Another proposal shortly to be considered by the Society is to bring closer together and to collaborate in some form with other bodies interested in particular aspects of glass.

It is felt by some that the scope of our Society should include every phase and treatment of glass. As a Society of Glass Technology it has devoted itself mainly and fundamentally to applying scientific methods and research to the problems of glass manufacture. That is its first and most legitimate aim, but it has not excluded other activities.

Now and again, but rarely, the artistry of glass has received attention. We have, for instance, discussed stained glass windows, after studying the noble examples at York, and we have inspected and admired at Stourbridge the fine craftsmanship of John Northwood in his exquisitely wrought replica of the classic Portland Vase; also that of the plaque by his son, Mr. John Northwood, which again is a masterpiece of technique.

These have been brief excursions from our normal course and on the whole the artistic side of glass has received rather slight attention from us. Yet it is a fact that glass has always been closely associated with art and the beauty of the material has always been a striking characteristic of our industry. Colour, form, design, and decoration in glass may be fascinating, and they constitute much of the attractiveness which glass has for many sections of the public.

It is felt that nothing in glass should be regarded as alien to the Society and we may well consider whether we should aim at including both science and art in our activities.

An opportunity may shortly occur to discuss whether it is desirable to co-operate with the British Society of Master Glass Painters, for instance, by some form of Federation, or affiliation, or other bond, enabling each to do its own work sectionally and allowing also for periodical combined work.

It is an idea from the fertile brain of Professor Turner and is worthy of being carefully considered in all its bearings.

In conclusion, I revert for a few moments to the great desideratum as regards membership.

Our Society includes in the scope of its operations every phase of the glass industry. It is a consummation devoutly to be wished that all the manufacturers engaged therein should be on our roll of members.

The glass department of the Sheffield University and the Society of Glass Technology are now, very palpably, an integral part of the industry—a necessity, not a luxury.

Education by research is vital to it. We cannot go back to pre-war days or turn our backs upon the great accession of knowledge as applied to the means and processes of manufacture. Together the Department and Society have done valuable and distinguished work to enlighten and educate the manufacturers. All occupied in the industry may well feel a sense of responsibility and assist in this work of education, which in turn helps and guides us in our factories, by the application of scientific principles to every stage of production.

Can we, by a special effort, induce the firms who have not hitherto joined the Society to come in now? And those who for various reasons have resigned, to rejoin? Personal persuasion might yield good results.

I would volunteer, during my term of office, to join with Professor Turner in a round of personal calls upon glass manufacturers, who are not members, if he were willing and if the Council approved of a special effort of this kind.

It is also desirable, I think, whenever the Society holds its monthly meetings at the different glass centres, to invite all the neighbouring glass firms to attend. Particular invitations would probably bring some of them in contact with our work and perhaps attract them to join.

Clearly we want and need the fullest possible representation of glass manufacturers and should leave no stone unturned to secure their aid. Our meetings are strong technologically. I think they are strong and vigorous from any point of view. But a fresh influx of manufacturers would contribute yet more strength and especially in the welcome form of practical experience straight from the factories and workshops.

Indeed, the Society's work would be encouraged and energised all round by a larger number of British manufacturers joining and participating actively in its undertakings.

A hearty vote of thanks was accorded to Mr. Butterworth, who then asked members to express their opinions, and to suggest steps which might be taken to improve and enlarge the work of the Society. In response to this request some discussion took place, the members contributing being Col. S. C. Halse, Messrs. E. A. Coad-Pryor, W. J. Rees, F. G. Clark, T. W. F. Robertson, L. M. Butterworth, Dr. S. English, Professor W. E. S. Turner, and Miss V. Dimbleby.

REVIEWS.

Die Glasfabrikation. Vol. I. Edited by Dr. Gustav Keppeler. Pp. 778+714 illustrations, and 16 folded plans. (R. Oldenbourg, Munich. Paper covers. Mk. 60. Bound in linen, Mk. 64.)

When, in 1911, Robert Dralle's *Die Glasfabrikation* was published, it was immediately accepted as the standard treatise on glass and glass manufacturing, a position it has held ever since. Owing, however, to the abnormally rapid increase in the knowledge of glass technology, and the consequent improvement in processes and equipment during recent years, a revision of the work became necessary.

Dralle died in 1918, so the task was undertaken by Dr. Keppeler, of the University of Hanover, in collaboration with several other experts, each of whom deals with the section of the industry with which he is most intimate, resulting in a treatise on glass technology that can be described without fear of contradiction, as being by far the best that has yet been published.

Following along the lines of the first edition this revised work is being published in two volumes, the second one being promised before the end of this year.

Even so an adequate description of the first volume would necessitate far more space than we have available, but a brief synopsis of the principal subjects discussed and described will be sufficient to show the scope of the work.

The first chapter is devoted to the physical and chemical principles upon which glass manufacture is founded, and is thorough and completely up-to-date. Raw materials, the melting, refining and annealing processes, fuels and gas producers, are dealt with in succeeding chapters, followed by a discription of the methods and principles of the control of furnace operation. This in turn is followed by chapters on refractories and glass furnaces. In all of them the use of numerous illustrations materially assists to a more ready understanding of the text.

One of the most remarkable sections of the book is the chapter on "Machines for the Working of Glass," which occupies some 220 pages. This is exceptionally complete, not with the usual manufacturer's illustrations and descriptive matter, but with really detailed accounts as to the operation and design of the different equipment. The machines covered include those for the production of bottles and containers, electric bulbs, and flat glass. Representative machines and processes are described in detail in each case.

The book is excellently printed, although small type has had to be used in numerous instances, in order to keep the size of the volume within reasonable limits. Our only regret is, that being published in German only at the present time, numerous glass manufacturers and others will not be able to enjoy the benefit of the information it contains.

Where to Buy Iron, Steel, Glass, in Belgium and Luxemburg. By H. L. Stiernet. (W. H. Smith & Son, Brussels. 20s. net.)

Although dealing primarily with the various sources of iron and steel, this book (which contains over 400 pages and is printed in English) also gives a deal of very useful information with respect to glass industry of Belgium and Luxemburg.

A list is given of all factories making window glass and also the trade marks used by each firm. In addition, factories using the Fourcault process and other mechanical processes are listed with notes in each case as to the colours, thicknesses, etc., produced.

Plate glass is treated in the same way, there being in addition some explanatory notes on the sales agreements between the various factories.

With regard to table ware, decorative glass, containers, rolled glass, etc., all the Belgian factories are listed in districts, with indications against each works as to the class and type of glass produced.

The book also contains some useful conversion tables, and should prove of real value to importers of glass of all kinds, steel, etc., as enabling them to get into immediate communication with factories making the particular goods they require.

Old English Drinking Glasses: Their Chronology and Sequence. By Grant R. Francis, F.S.A. (Herbert Jenkins, London. 63s. net.)

This handsome volume, finely bound, splendidly illustrated by no fewer than 71 plates, and printed on first-class paper, is a production of which the author (previously well known for his activities as President of the British Numismatic Society) may well be proud. In comparison with the cost of recent glass text books this latest addition to the large sized volumes that appear unavoidable, is remarkably good value at three guineas and the autographed edition de luxe, with its superior binding (limited to 100 copies), is a great temptation to the keen collector in that it contains additional illustrations of several truly remarkable Jacobite specimens.

Since the day of the publishing of Hartshorne's masterpiece of industrious research (we avoid "monumental work" for even eloquent descriptive terms become monotonous when too frequently employed) no such useful book has been produced. Admirable as *Bate* was it could not compare with the book under review, limited in scope as it was in order to sell at a popular price. Other finely illustrated works have appeared, but dealing chiefly with those unobtainable "museum" specimens, which are more calculated to plunge the young collector in despair, than to encourage him to continue his search for representative examples. In this work he finds just the help he needs in the numerous illustrations of glasses showing their relationship to each other and their sequence. From the 380 illustrations alone he can form a definite idea of what examples are necessary in a representative collection of 18th century drinking glasses.

There is "milk" for the beginner and "strong meat" for the advanced collector, but we are bound to deplore the assurance with which the author sets aside the accepted deductions of the early day glass student and substitutes far-fetched theories based on supposition only. This applies particularly to his conjectures on champagne and sweetmeat glasses and to his somewhat drastic revision of the dates of the inception of new types. The chapter on Jacobite glasses is both illuminating and instructive, tracing as it does the inspiration of many of the engravings to well-known coins and metals. The author's numismatic knowledge here stands him in good stead and many interesting facts are deduced and placed on record for the first time. Other conjectional theories, such as experimental wine glasses being made at window glass factories, we view with diffidence, and shall need further evidence before we can accept them as proven. We repeat, the book will be of great service to the beginner, access to the series of illustrations will enable every budding collector to grasp all the main characteristics of 18th century wine glasses, and they will be invaluable as a medium of identification in correspondence with fellow collectors. We are fully in agreement with the author when he states: "The present low prices ruling can be but a passing phase—now therefore is the opportunity for intelligent collectors who care to really study glass, and to form collections at prices which future years can never repeat." And we believe this book will assist many to reap the benefits which will accrue to them in following this good advice.

C.D.

Old Glass, European and American. By N. Hudson Moore. Hodder & Stoughton, Ltd., London, £2 2s. 0d.

The chief value of this addition to the ranks of text books on Glass lies in the fact of its presenting to the public for the first time in one volume a brief sketch of the history of glass making in all the principal centres. Little information has previously been available in this country of the products of the American factories, and it is in respect of this section of the volume that Mr. Hudson Moore's book will find a welcome. The similarity of the early American productions (if those illustrated can be accepted as authenticated specimens) with those of the European centres from whence the craftsmen emigrated provides an instructive and interesting study. The book yields little food for the advanced collector, as the brief résumé of each factory appears to be largely composed of extracts from various works previously published, and the author is so dependent upon the opinions of others as to run the risk of being judged to have a rather scanty practical knowledge himself. This lack of originality is also to be noticed in the illustrations of Part I (European Glass), many of which have already appeared in other well known text-books. Those depicting specimens emanating from the later American factories convey eloquently to the English collector the difference in the taste of his American cousin.

C.D.

◆

SOCIETY OF GLASS TECHNOLOGY.

The Next Meeting
London, December 15th, 1926.

The next meeting of the Society will be held in University College, Gower Street, London, on Wednesday, December 15th, 1926, at 2.30 p.m. A selection from the following papers will be read.

(a) **"Some Corrosion and Erosion Phenomena and Their Bearing on the Macrostructure of Refractories,"** by J. F. Hyslop, R. Gumm, and H. Biggs.

(b) **"A Note on the X-ray Patterns of Mullite and Sillimanite,"** by J. F. Hyslop and H. P. Rooksby.

(c) **"The Effect of Cullet on the Melting of Glass,"** by Professor W. E. S. Turner.

(d) **"A Further Note on Sillimanite as a Glass Works Refractory,"** by Professor W. E. S. Turner.

(e) **"The Design of Parison Moulds,"** by S. English, D.Sc.

(f) **"The Viscous Properties of Glass"** by V. H. Stott, M.Sc.

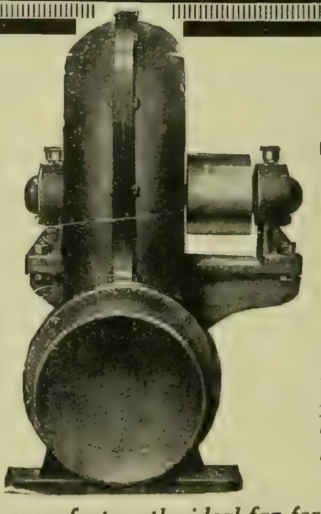
Papers (a) and (b) are communications received from the Research Laboratories of the General Electric Co. Ltd., Wembley.

It is hoped that a second session will be held after tea, and will take the form of a Joint Conference with the British Society of Master Glass Painters.

Arrangements have been provisionally made for members to visit the Milk Bottling Plant at Streatham, London, of the United Dairies, Ltd. This plant has a capacity of 160,000 pint bottles per day, and it is expected that this visit will take place during the afternoon of Tuesday, December 14.

◆

A well known Stourbridge firm of glass manufacturers has recently completed two complete table sets (each consisting of about 250 pieces) entirely in glass.



Successful Mould Cooling

The modern method for cooling your mould successfully is not by robbing your main compressor, but by using a big volume fan.

We manufacture the ideal fan for this purpose, which assures a constant stream of cold Dry Air for a small expenditure of power.

May we send you our catalogues **G.L. 1019** *and* **1242** *and more particulars.*

STURTEVANT
ENGINEERING Co., Ld.
149, Queen Victoria St.,
LONDON
E.C. 4

MANCHESTER
196, Deansgate

GLASGOW
50, Wellington Street.

October Trade Returns.

IMPORTS OF GLASS AND GLASSWARE.

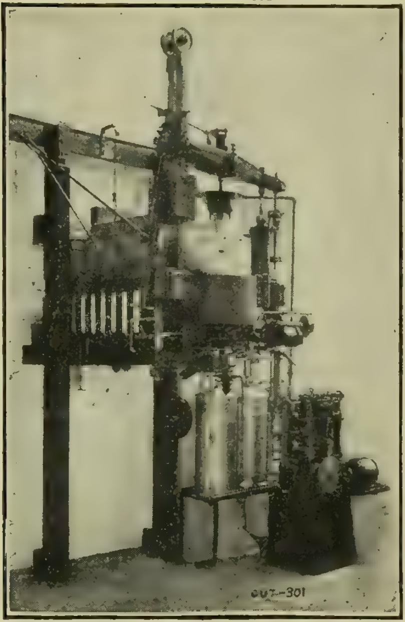
		Quantities.				Value.			
		Month ended 31st Oct.		Ten months ended 31st Oct.		Month ended 31st Oct.		Ten months ended 31st Oct.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)...	value	--	—	—	---	6,404	4 300	51,753	53,733
Glass Tubing and Rod for all purposes... ...	cwts.	576	453	5 469	5,486	1,851	2,384	17,349	19,232
Illuminating Glassware	,,	15 966	14 146	127,505	131,473	47,261	42,145	341,780	386,603
Machinery Glassware	,,	34	24	249	162	268	129	2,147	1,200
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	64,222	54 526	486,128	504 411	170,6 1	160,853	1,325 915	1,400,690
Plate and Sheet Glass	,,	105 162	125,899	938 535	1,111 911	135 227	157 626	1,356,672	1,472 067
Optical Glass (other than worked Elements, e.g. Lenses)	,,	5	5	47	2	56	471	3 497	2 418
Bottles and Jars	gross	130 474	139,180	1,079 621	1,219,419	75 624	89 510	670 208	754 776
Glass and Glassware not elsewhere specified ...	cwts.	2 135	5 292	19,6 9	30 3 0	6 451	9 837	61 125	75 204
Total Value	£	—	—	-	-	443,823	467,255	3,830 446	4 165 923

EXPORTS OF GLASS AND GLASSWARE (BRITISH PRODUCTS).

		Quantities.				Value.			
		Month ended 31st Oct.		Ten months ended 31st Oct.		Month ended 31st Oct.		Ten months ended 31st Oct.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)...	value	—	--	---	—	3,850	6,830	54 560	59,034
Tubing and Rod for all purposes	cwts.	175	479	2,733	4,010	1,075	2 410	18 361	23 434
Illuminating Glassware	,,	581	532	5,162	5 115	5,766	5 957	48 496	46,392
Machinery Glassware	,,	355	151	3,630	2,04	2 279	1,473	25 058	16,235
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	3,308	3,275	29,081	26 205	33,611	36,760	270,606	266,948
Plate and Sheet	,,	87,169	62 196	694,456	717,53	143,262	121,321	1,306 090	1,319,689
Optical (other than worked Elements, e.g. Lenses)	,,	3	6	78	72	104	124	2,028	2,060
Bottles and Jars	gross	28,819	28,887	279,463	248,261	29,856	29,501	278,473	236,272
Manufactures, not elsewhere specified	cwts.	707	714	6,325	7,216	5,366	4,302	38,272	44,314
Total Value	£	--	—	-	—	225,169	208,678	2,041,944	2,014,378

EXPORTS OF GLASS AND GLASSWARE (FOREIGN AND COLONIAL MERCHANDISE).

		Quantities.				Value.			
		Month ended 31st Oct.		Ten months ended 31st Oct.		Month ended 31st Oct.		Ten months ended 31st Oct.	
		1925.	1926.	1925.	1926.	1925.	1926.	1925.	1926.
Scientific Glassware (except Tubing and Rod)...	value	--	—	--	—	675	376	5,219	4,611
Glass Tubing and Rod for all purposes ...	cwts.	5	—	16	8	26	1	183	115
Illuminating Glassware	,,	338	184	1,698	1,837	2,158	1,348	12,404	13,823
Machinery Glassware	,,	—	—	1	4	1	—	27	104
Domestic and Fancy Glassware (including Cooking Utensils, Table Glassware, Ornamental Glassware)	,,	1,139	928	7,935	7,771	6,862	5,683	50 554	51,728
Plate and Sheet	,,	620	213	2,641	4 102	527	276	3 428	4 321
Optical Glass (other than worked Elements, e.g. Lenses)	,,	9	8	42	45	21	94	312	476
Bottles and Jars	gross	4,616	2,242	24 086	16 822	3,030	2,362	20,462	15 270
Glass and Glassware not elsewhere specified ...	cwts.	42	37	580	425	354	211	3 520	2,645
Total Value	£	--	—	—	--	13,654	10,351	96,109	93,093



MODEL KrO.

Latest Miller Feeder

PROGRESSIVELY DEVELOPED SINCE 1907.

By arrangement with **The Morgan Crucible Co., Ltd., Battersea,** a stock of all refractory parts for our feeders is now kept in London.

WILLIAM J. MILLER, Inc., SWISSVALE, PA., U.S.A.
London Office : **366, Strand, London, W.C.2.**
Tel. No.: Regent 5647.
Cables : Autoglasma, Rand, London.
Autoglasma, Pittsburg, Pa.

TORPEDO and WASP-SHAPE TANK FURNACES

(Designed under Moorshead's Patent No. 227,939)

Constitute the LATEST PROGRESS in Tanks.

INCREASE LIFE OF BLOCKS
Avoid stagnant metal.
Save fuel as the corners do no melting.
Ensure smooth running.

By arrangement with Messrs. **U.G.B.,** I can now supply customers in Great Britain and Ireland with these modern types, WHICH ARE SUPERSEDING THE OLD SQUARE TANKS AT MESSRS. **U. G. B. Co.'s** UP-TO-DATE WORKS AT CHARLTON & ST. HELENS, etc.

Send for full particulars and let me quote for altering your old tanks.

TH. TEISEN, C.E.,

FURNACE ENGINEER,

20a, TEMPLE STREET, BIRMINGHAM.

Telephone : Central 1806. *Telegrams : "Tete, Birmingham."*

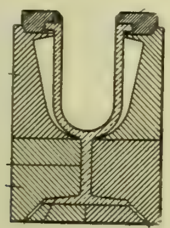
United States Patents.

GRANTED OCTOBER 19th, 1926.

1,603,479.—**Apparatus for Making Glassware.** John J. Lentz, Butler, Pa. Filed July 22, 1925. Serial No. 45,324. Renewed August 19, 1926. 3 Claims. (Cl. 49—55.)

1. In an apparatus of the class described, means for regulating the flow of glass comprising a frame, a vertical shaft journaled for rotation in bearings on said frame, upper and lower friction driving discs carried by said shaft, a feed screw connected to the lower end of the shaft, and an adjustably mounted motor disposed in close proximity to said discs, there being a friction driving disc on the shaft of said motor co-operable with either one of the first named discs.

1,603,524.—**Method of Manufacturing Stemmed Glassware.** George S. Dunbar, Columbus, Ohio, assignor to The Federal Glass Company, Columbus, Ohio, a Corporation of Ohio. Filed September 29, 1924. Serial No. 740,481. 9 Claims. (Cl. 49—80.)



1. The method of manufacturing stemmed glassware which comprises depositing a charge of glass in a mould, moving an implement into the mould to form a blow blank, the same implement forming a stem and base integral with the blow blank from the same mass of glass and subsequently blowing the blank.

1,603,552.—**Process and Apparatus for Producing Crackled Glassware.** David L. Middendorf, Columbus, Ohio, assignor to The Federal Glass Company, Columbus, Ohio, a Corporation of Ohio. Filed February 4, 1926. Serial No. 85,872. 19 Claims. (Cl. 49—80.)

3. The method of manufacturing crackled glassware which comprises impinging an atomized fluid upon the forming surface of a mould and then forming an article in said mould.

5. Apparatus for producing crackled glassware comprising a blank mould having a metallic forming surface, means for spraying the forming surface of said mould with atomized water to produce a crackled exterior surface on the blank to be formed therein, means for forming a glass blank in said mould, a blow mould and means for blowing a blank positioned therein.

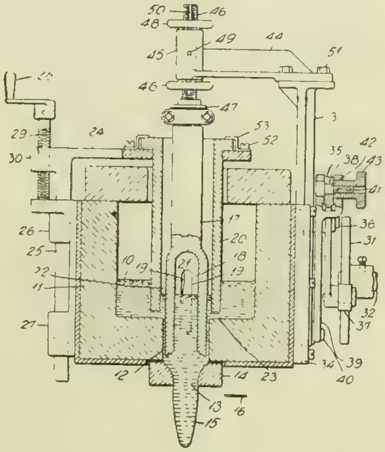
11. The method of manufacturing crackled glassware which comprises pressing a blank in a mould and forming a crackled surface thereon, and later blowing the blank so produced.

19. In press and blow apparatus, a parison mould, and means associated with said mould for subjecting the glass to a chilling sufficient to produce crackling in the finished article.

1,603,598.—**Method and Apparatus for Producing Plate Glass.** James G. Haworth, Rossford, Ohio, assignor to The Edward Ford Plate Glass Company, Rossford, Ohio, a Corporation of Ohio. Filed June 23, 1926. Serial No. 117,930. 7 Claims. (Cl. 49—34.)

2. In combination, a plate glass casting table, means for progressively flattening a batch of glass on the table, and a member movable over a portion of the table, and the initially formed end portion of the glass plate for retarding the cooling of such portion of the plate.

1,603,862.—**Apparatus for Feeding Molten Glass.** Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed December 8, 1922. Serial No. 605,681. 13 Claims. (Cl. 49—55.)

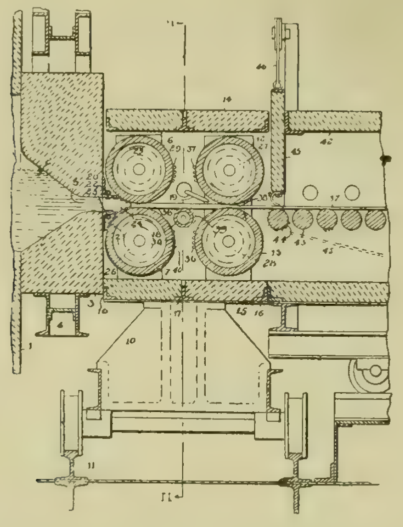


1. In apparatus for segregating mould charges from a body of molten glass, the combination with a container for the glass provided with a discharge outlet, of a member having an internal flow passage into and through which the glass can flow by gravity to the outlet, and means for reciprocating said member to periodically accelerate or retard the gravitational flow to the outlet.

1,603,949.—**Apparatus for Cleaning Plate Glass Polishing Runners.** Herman S. Heichert, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed March 23, 1923, Serial No. 627,083. Renewed March 31, 1926. 5 Claims. (Cl. 51—266.)

1. In combination in apparatus for polishing plate glass, a series of polishing machines, each having a rotatable frame provided with a set of polishing runners, means for carrying the glass to be polished beneath the runners of the series of machines, means for applying water to the machines to wash out the polishing material from the runners, fixed supporting means along the line of travel of the means carrying the glass on each side thereof, and shields between the machines extending across the glass to prevent the water employed in washing one machine from passing to the next machine, said shields being mounted upon said supporting means for vertical movement so that they may be moved out of contact with the glass when the washing operation is not in progress.

1,603,946.—**Apparatus for Making Sheet Glass.** Frederick Gelstharp, Tarentum, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed May 7, 1923. Serial No. 637,128. 5 Claims. (Cl. 49—3.)

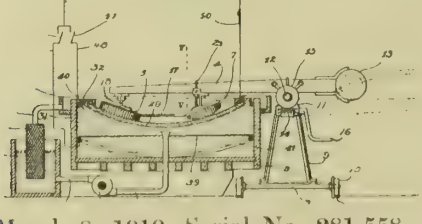


1. In apparatus for making sheet glass continuously in a sheet or ribbon, the combination with a tank or receptacle for molten glass provided with an outlet through its side wall so located as to permit the discharge therethrough under the head pressure of the tank, of sheet forming rolls at such outlet with their pass under said head pressure arranged to control the rate of flow of the glass from said outlet and spaced apart a distance greater than the thickness of the finished sheet, and a second pair of rolls in advance of the first pair spaced apart a less distance than such first pair and serving to reduce the thickness of the sheet or ribbon.

1,603,950.—**Apparatus for Cleaning Plate-Glass Polishing Runners.** Herman S. Heichert, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Filed March 23, 1923. Serial No. 627,084. 4 Claims. (Cl. 15—21.)

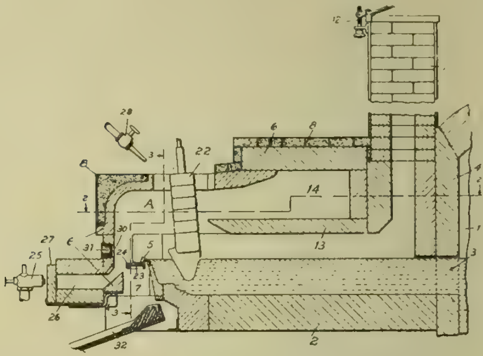
1. Apparatus for use in cleaning a set of the vertically movable runners of a series of plate glass polishing machines mounted above means for carrying the glass there-beneath, comprising a washing pan adapted to receive a set of said runners and mounted for movement longitudinally of the series of polishing machines intermediate the means for carrying the glass and the runners when the runners are raised.

1,603,951.—**Process for Making Mirrors or Reflectors.** Halbert K. Hitchcock, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company, a Corporation of Pennsylvania. Original application filed March 8, 1919, Serial No. 281,558. Divided and this application filed November 17, 1923. Serial No. 675,417. 3 Claims. (Cl. 204—11.)



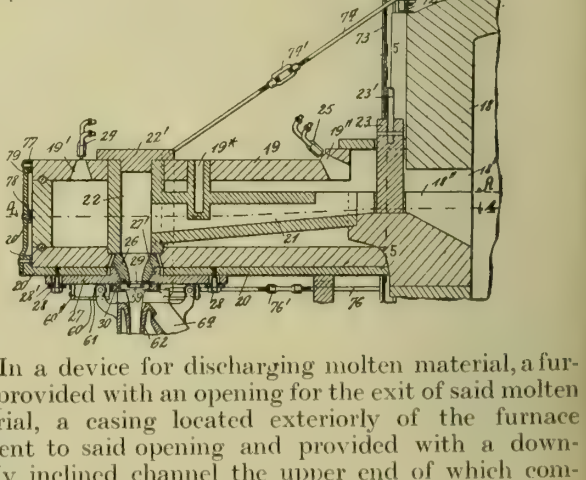
3. The process of electroplating a reflector which consists in silvering the back and edge of a glass plate, depositing a band of metal upon said edge by electrolysis, and then depositing a metal coating by electrolysis on said back and extending over said band.

1,603,974.—**Apparatus for Conditioning Molten Glass.** Vergil Mulholland and Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed October 16, 1919. Serial No. 331,237. 7 Claims. (Cl. 49—55.)



7. Glass conditioning apparatus, including a container for molten glass, a firing space, a baffle between said container and said space for directing heated gases over the surface of the glass in said container, a stack in communication with the container, and means operable in conjunction with the stack for controlling the admission of gases from the firing space into the container.

1,603,994.—**Device for Discharging Molten Material.** Merton A. Steelman, Vineland, N.J.; Anna Martha Steelman, administratrix of said Merton A. Steelman, deceased, assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed June 6, 1916, Serial No. 101,878. Renewed October 29, 1924. 29 Claims. (Cl. 49—55.)



2. In a device for discharging molten material, a furnace provided with an opening for the exit of said molten material, a casing located exteriorly of the furnace adjacent to said opening and provided with a downwardly inclined channel the upper end of which communicates directly with said opening at the level thereof, a nozzle connected with the lower end of said channel, means for cutting off the supply of molten material at the upper end of said channel directly adjacent to said exit opening of the furnace, and a cutter movable adjacent to the outlet of the nozzle.

9. In a device for discharging molten material, a

casing provided with an upright discharge chamber, means for supplying material to said chamber between its top and its bottom, a nozzle at the bottom of said chamber, and a removable cover, located in line with said nozzle, for normally closing the upper end of said chamber.

25. In a device for discharging molten material, a furnace, a nozzle, means for conveying material from said furnace to said nozzle, and means permitting said nozzle to be adjusted laterally toward and from the furnace.

1,604,000.—**Method and Apparatus for Delivering Viscous Glass.** Oliver M. Tucker and William A. Reeves, Columbus, Ohio, assignors by mesne assignments to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Original application filed August 12, 1918, Serial No. 249,421. Divided and this application filed September 29, 1924. Serial No. 740,479. 17 Claims. (Cl. 49—55.)

1. A spout for delivering viscous glass from a furnace comprising a body portion with a delivery aperture therein, and a removable cover block closing the top of the spout adjacent the delivery aperture, said block having a port therein which is adapted to direct temperature modifying fluid forwardly and downwardly into said spout and to the glass adjacent to said delivery aperture.

GRANTED OCTOBER 26th, 1926.

1,604,459.—**Mirror and Process of Making It.** Robert E. Lyons, Bloomington, Ind., assignor to The Nurre Mirror Plate Company, Bloomington, Ind., a Corporation of Indiana. Filed March 31, 1926. Serial No. 98,719. 14 Claims. (Cl. 41—22.)

7. The process of mirror-making, which consists in treating the glass surface with a solution of gum arabic, and applying upon such treated glass surface the solution used in depositing the desired mirror-metal.

12. A mirror, comprising a glass, a non-metal colour-film on parts of the surface of such glass, and a layer of precipitated silver on and adhering to both such colour-film and parts of the surface of the glass which are not covered by the colour-film.

1,604,557.—**Method of Manufacturing Decorative Glassware.** Paul W. Jenkins, Charleroi, Pa., assignor to Macbeth-Evans Glass Company, Pittsburgh, Pa., a Corporation of Pennsylvania. Filed September 10, 1924. Serial No. 737,009. 2 Claims. (Cl. 49—79.)

1. The method of manufacturing an incrusted glass article, which comprises blowing a mass of plastic glass within a mould having an area of its surface provided with a relief design, and by such blowing simultaneously shaping the article and forming a shallow coating-retaining relief design of sharp outline on an area of the outer surface of the article, and subsequently forming an adherent coating on said relief area of the article.

1,604,781.—**Air-Supply System for Glass-Drawing Machines and Processes.** Louis G. Neurohr, New Kensington, Pa., assignor to Window Glass Machine Company, Pittsburgh, Pa., a Corporation of New Jersey. Filed December 2, 1922. Serial No. 604,561. 13 Claims. (Cl. 49—17.1.)

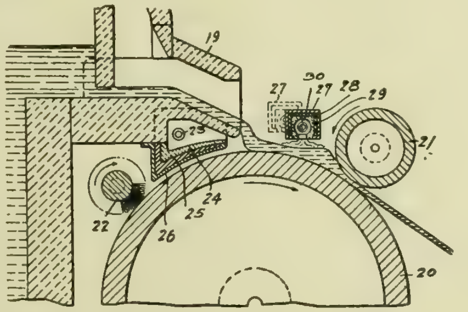
8. Those steps in the herein described method of blowing machine drawn glass cylinders having caps, which consist in withdrawing a bait from a bath of molten glass to commence a draw and supplying air to the cylinder through a conduit having a constantly open unregulated vent therein and connected to a source of pressure through branch pipes, one containing the usual automatic graduating valve and the other containing a manually operable valve, opening the manually operable valve to admit air at sufficient pressure to distend the cap in spite of the open vent, and thereafter closing the manually operated valve and drawing the cylinder proper.

1,604,823.—**Method and Apparatus for Flattening Sheet Glass.** John Hartzell, Arnold, Pa., assignor to Window Glass Machine Company, Pittsburgh, Pa., a Corporation of New Jersey. Filed October 17, 1924. Serial No. 744,154. 11 Claims. (Cl. 49—4.)

1. Glass flattening apparatus, including a flattening oven, a flattening wheel therein having flattening surfaces adapted to be moved to successive position by rotation of the wheel, means for supplying heat above one of such positions, means for passing cooling fluid below said position and a succeeding position, a partition between such positions, and means for withdrawing hot gases from above said succeeding position.

GRANTED NOVEMBER 2nd, 1926.

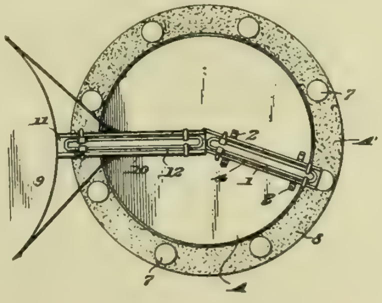
1,605,736.—**Method of and Apparatus for Forming Sheet Glass.** George E. Howard, Butler, Pa., assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed February 2, 1926. Serial No. 85,485. 25 Claims. (Cl. 49—3.)



1. The method which comprises directing a stream of glass toward a relatively wide sheet-forming member, and dividing said stream into a plurality of laterally spaced portions, at a point in advance of its engagement with said member.

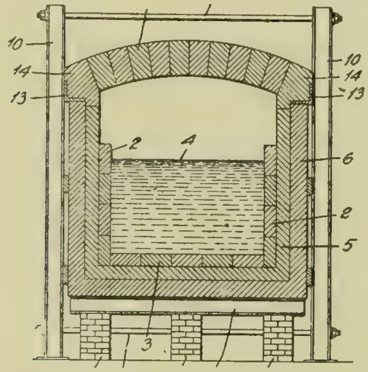
1,605,797.—**Glass-Moulding Machine.** Andrew H. Tyson, Washington, D.C. Filed July 20, 1925. Serial No. 44,886. 4 Claims. (Cl. 49—5.)

1. In moulding machinery, the combination with a



turntable or revolving mechanism carrying an inclined trough which extends approximately from the centre to the periphery thereof, of a spout or outlet which extends above said trough and to a point approximately coincident with the centre of the table, and a plurality of moulds disposed in circular form beneath the discharge end of the trough.

1,605,885.—**Glass-Furnace.** Paul G. Willetts, Berlin, Conn., assignor to Hartford-Empire Company, Hartford, Conn., a Corporation of Delaware. Filed June 24, 1926. Serial No. 118,235. 13 Claims. (Cl. 49—54.)



1. A glass furnace having at least a part of the glass engaging portion of its bottom composed of refractory blocks which are of greater specific gravity than the molten glass to be contained in said furnace, and which therefore cannot be dislodged by floating in said glass.

GRANTED NOVEMBER 9th, 1926.

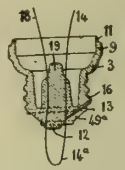
1,606,128.—**Chuck for Stem Ware.** Alvah C. Parker, Toledo, Ohio, assignor to The Libbey Glass Manufacturing Company, a Corporation of Ohio. Filed August 13, 1925. Serial No. 49,972. 4 Claims. (Cl. 49—64.)

1. A chuck for stemmed ware comprising a fork adapted to contact the upper surface of the foot of an article, a parallel fork adapted to contact the lower surface of the bowl of an article, means connecting the two forks for sliding movement towards and away from each other and means constantly tending to separate the forks.

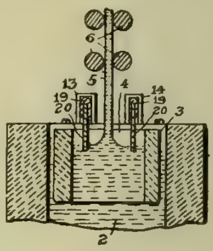
1,606,276.—**Apparatus and Method for the Production of Incandescent Lamps.** Leopoldo Sanchez Vello, Paris, France. Filed October 21, 1922. Serial No. 596,173, and in Spain October 29, 1921. 24 Claims. (Cl. 49—2.)

1. The method of producing lamp heads of the kind described, comprising the steps of positioning contact wires in a mould, introducing molten glass into the mould in direct contact with the walls thereof, and around the wires, inserting a punch into the mould to shape the inner surfaces of the lamp head, and extracting the lamp head from the mould.

4. Apparatus for making glass lamp heads of the kind described, comprising a mould adapted to receive molten glass in direct contact with its wall, a base for said mould, a claw guided in said base for holding the leading in wires of the lamp head during the moulding thereof, a core punch with ducts therein for the leading in wires, means for bringing the mould and core punch into and out of co-operative relationship with each other, extractor means for removing the finished lamp head from the apparatus, and means for operating the claw and the extractor means.

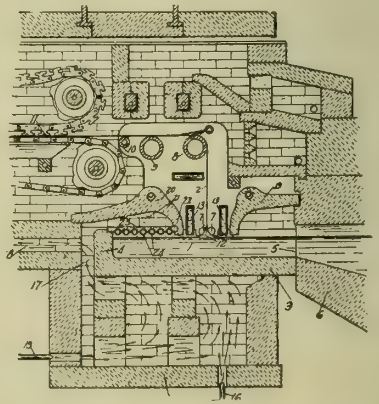


1,606,298.—**Apparatus for Manufacturing Glass.** Leon J. Houze, Sr., Point Marion, Pa. Filed January 10, 1925. Serial No. 1,592. 4 Claims. (Cl. 49—17.)



1. An apparatus for the purpose set forth comprising a pair of spaced horizontally disposed agitators adapted to extend into a bath of molten glass, supporting elements for said pair of agitators, said pair of agitators being arranged parallel with respect to each other and shiftably mounted in said supporting elements, and means operable for imparting a reciprocal movement to said pair of agitators for agitating said bath of molten glass.

1,606,409.—**Sheet-Glass-Drawing Apparatus.** Arthur E. Fowle, Toledo, Ohio, assignor to The Libbey-Owens Sheet Glass Company, Toledo, Ohio, a Corporation of Ohio. Filed April 20, 1923. Serial No. 633,427. 9 Claims. (Cl. 49—17.)



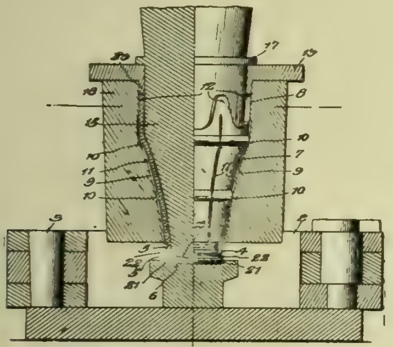
1. In combination, a receptacle containing molten glass and a protecting and heating means for the surface glass, comprising a cover plate for the receptacle and exposed electric heating elements mounted on the plate above the molten glass and out of contact therewith.

1,606,481.—**Neutral Refractory Cement.** William F. Rochow, Pittsburgh, Pa., assignor to Harbison-Walker Refractories Company, Pittsburgh, Pa., a

Corporation of Pennsylvania. Filed January 20, 1923. Serial No. 614,046. 7 Claims. (Cl. 106—9.)

1. A refractory composition comprising an intimate mixture of a powdered aluminium oxide and powdered sodium silicate.

1,606,687.—**Method of Making Flower-Vase Inserts.** Arthur James Bennett, Cambridge, Ohio. Filed March 12, 1924. Serial No. 698,746. 2 Claims. (Cl. 49—79.)



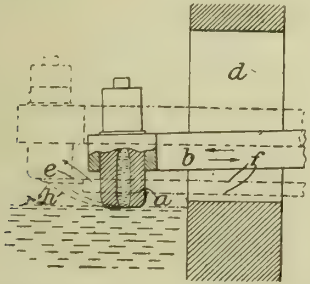
2. The hereindescribed method of making flower inserts, which consists in pressing a mass of glass into the form of a hollow body and in confining the axial and lateral movements of the mass to form a series of spaced spikes extending axially outwardly from an end of the body, then in heating the spikes and individually bending same inwardly to lie laterally of the body and with their sides spaced and with their tips arranged in a circular series surrounding the axis of the body.

BRITISH PATENTS.

The following abstracts are taken from the Illustrated Official Journal of Patents with the special permission of the Controller of H.M. Stationery Office.

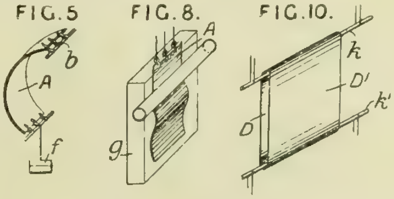
Printed copies of the full specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C., price 1/- each.

257,536.—**Glass Manufacture.** Soc. Anon. D'Etudes et de Constructions d'Appareils Mecaniques Pour La Verrerie, 3, Rue de Castellane, Paris. May 4, 1926, No. 11699. Convention date, March 3. (Class 56.)



Gathering molten metal.—Relates to machines of the kind in which a parison mould a, carried by an arm b of the machine, is thrust through an opening d into the interior of a furnace and is lowered in order to gather a charge of metal by suction. The mould is then lifted and before it is withdrawn from the furnace, a blade e, carried by an arm f, moves forwards and severs the string of metal depending from the parison. According to the invention, the mould a, as it rises after having made a gather, continues moving towards the interior of the furnace, the blade e making a cutting-stroke towards the end of this supplementary movement. The string h of metal severed by the blade thus falls towards the interior and hotter part of the furnace, and the area of metal from which gathers are taken is left clean for the next gather.

257,590.—**Glass Manufacture.** Manufactures des Glaces et Produits Chimiques de St. Gobain, Chauny, et Cirey, I^{bis}, Place des Saussaies, Paris. August 12, 1926, No. 19907. Convention date, August 27, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act (Class 56.)



Flattening.—A method of flattening curved sheets or cylinders of glass consists in heating the glass to a suitable temperature and stretching it until it is flat. The curved sheet A, Fig. 5, which may be supported either vertically or horizontally, is secured at end to a bar b while the other end is attached to a weight f. When the glass is brought to a suitable temperature, the sheet opens out and is stretched into a flat form by the weight f. When the sheet is thin, its weight may be sufficient to stretch it, but when it is thicker, or hard, it may also be pressed between vertical slabs or passed between rollers, or it may be rolled against a vertical slab g, Fig. 8. A cylinder may be stretched by suspending it from a bar k, Fig. 10, and suspending weights from another bar k^1. The curved ends of the stretched cylinder can then be cut away, leaving two flat sheets D, D^1.

257,637.—**Glass Manufacture.** Rushen, P. C., 28, Southampton Buildings, London. — (Hartford-Empire Co., 333, Homestead Avenue, Hartford, Connecticut, U.S.A.) March 7, 1925, No. 6316. (Class 56.)

Blowing; delivering molten metal.—Apparatus for making bottles or similar glassware comprises a number of independent forming machines A, Figs. 1 and 2, a delivery mechanism B for conveying charges of glass from a feeder to each of the machines, and a timing-device C for controlling the operations of each machine in proper timed relation to one another and to the feeding-device.

Forming machines. The machines A are preferably arranged side by side and each comprises an inverted parison mould 1, Figs. 4 and 13, a finishing mould 2, and a ring mould 3 which is adapted to swing about a horizontal axle 97 to transfer a parison from the parison mould to the finishing mould 2. The operation is so arranged that a parison is formed in the parison mould at the same time that the previously formed parison is being blown to its final form in the finishing mould. The parison mould sections are hinged on a pin 11, Fig. 4, and are opened and closed by an air cylinder 14. The open end of the mould is closed by a cover or baffle plate 32 carried by an arm 35 adjustably secured to the piston rod 41 of an air cylinder 42. The other end of the rod has a pin which engages in a cam slot 52 formed in a tubular extension 51 of the cylinder 42. Thus, as the cover is lifted from the mould, it is swung to one side out of the path of the ring mould 3.

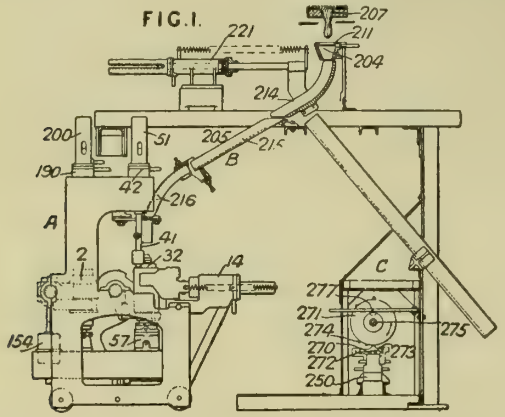


FIG. 1.

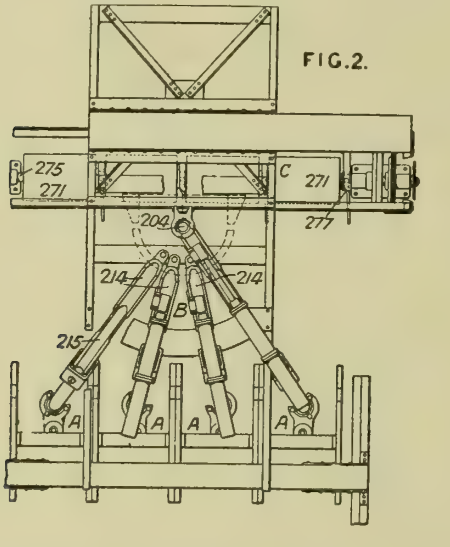


FIG. 2.

During the parison-forming operation, the ring mould 3 is positioned below the parison mould 1, and a mouth-forming plunger 71, Fig. 13, is projected into the ring mould by an air cylinder 57. This cylinder is provided with two pistons one of which, 60, has a tubular piston-rod 61 carrying a head 63 that seats against the underside of the ring mould. The other piston, 67, has a piston rod 70 which slides through the rod 61 and carries the mouth-forming plunger 71. Suction is applied to the ring mould to settle the charge of glass, through a pipe 80 which communicates with the space between the two pistons and thence through passages with the interior of the ring mould. Pressure is then applied through the pipe 80, and this forces the piston 67 downwards and withdraws the plunger 71 from the ring mould. At the same time, the pressure is transmitted to the ring mould and counterblows the charge to form a parison.

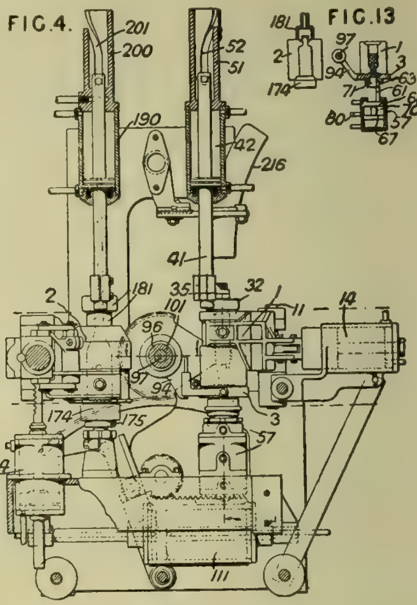


FIG. 4. FIG. 13

When the parison is formed, the mould 1 is opened and the axle 97, Fig. 4, is rocked by a cylinder 111 in order to turn over the arms 94 on which the ring mould is mounted and thus to transfer the parison to the finishing mould 2. The arms 94 each carry a section of the ring mould and each is carried by opposed cylinders 96 slidably mounted on the axle 97 and pressed towards one another along a common piston 101 by springs. When air is admitted to the cylinders, they are forced apart and open the ring mould. The finishing mould halves are opened and closed by a cylinder 154, and the bottom plate 174 is carried by a holder adjustably mounted on the baseplate of the machine. A blowhead 181 is raised or lowered by the piston of an air cylinder 190 which is provided with an extension 200 having a slot 201 to swing the blowhead to one side as with the baffle plate 32.

Delivering molten metal. The means for delivering the mould charges to the different forming machines comprise a funnel 204, Figs. 1 and 2, which receives the charges from a feeder 207, and a number of guideways 205 which extend from the funnel to the machines. The funnel has its inner surface lubricated by air or steam projected from an annular chamber 211 mounted over its upper edge. Each guideway comprises a trough section 215, a deflector 216, and a reciprocating distributor 214 which is carried by the piston rod of a cylinder 221. The cylinders are operated in succession, so that the distributors 214 are brought in turn beneath the funnel and deflect the charges in succession to the troughs 215.

Timing the operations. The pressure-controlling mechanism, for timing the operations of the different parts of the machines and of the delivery mechanism, comprises a valve chest 250 which is connected to the various cylinders by air pipes. Air is admitted to these pipes by valves actuated by levers 272, Fig. 1, which are operated by studs 270 adjustably secured to a constantly-rotating drum 271. The valves are held open by latches 273 until they are tripped by studs 274 on the drum. A number of drums are mounted on a shaft 275 which is driven in timed relation with the feeder, and each drum may be disconnected from the shaft by a clutch 277.

257,641.—**Glass Manufacture.** McNish, A., and Automatic Bottle Machine Corporation, Ltd., 12, Henrietta Street, London, April 6, 1925. No. 9132. (Class 56.)

FIG. 4

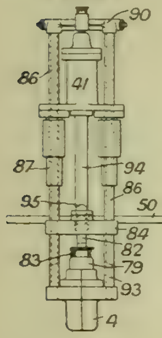
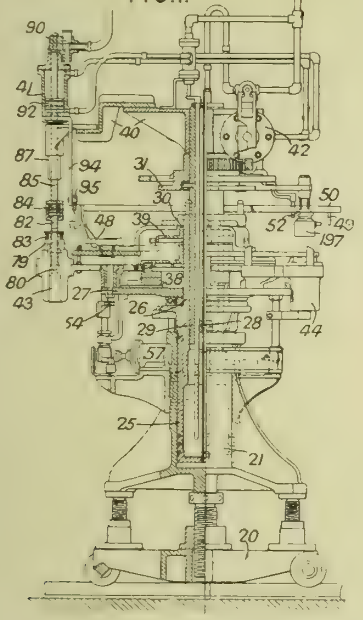


FIG. 1.



Blowing; gathering.—A blowing-machine of the suction-gathering type comprises a horizontal rotary mould-supporting table which is movable vertically to enable a parison mould to gather a charge of metal, the rotation of the table being stopped while a gather is being made. The machine comprises a wheeled truck 20 on which a vertical cylinder 21 is adjustably mounted, the piston 25 carrying a column 26 on which a mould table 27 is rotatably mounted. The upper end of the cylinder carries a crosshead 28 which passes through slots in the piston column 26 and is rigidly secured to an inner column 29. A clutch element 30, secured to the table 27, rotates on the column 26, and the other element 31 of the clutch is rotatably mounted on the column 29. The table 27 carries three parison moulds 43, and corresponding finishing-moulds 44, and when in the lowermost position, shown in Fig. 1, one of the parison moulds is dipping into the metal in an open trough or hearth, such as that described in Specification 244,834, and is gathering a charge by suction. When air is admitted below the piston 25, the table 27 is lifted and lifts the mould away from the supply of metal. At the same time, the clutch members 30, 31 are engaged and rotation of the member 31, by an air cylinder 42, rotates the table 27 and brings a new mould to the gathering-position. A wiping-arm 54, pivoted below the table 27, and operated by a cylinder 57, removes surplus metal from the bottom of the parison mould as it is lifted after making a gather. The parison and finishing moulds are pivoted on the table 27 and they are opened and closed by a cam 38 fixed to the column 26. Resilient connections between the moulds and their operating gear prevent damage in the event of an obstruction. The moulds are arranged alternately, and a parison is transferred from a parison mould to its corresponding finishing mould by means of the ring mould 79, which is carried by a swinging arm 48. This arm is pivoted to the table and is operated by a cam 39 also fixed to the column 26. A ring mould is opened, as it swings over the finishing-mould, by a pin 49 depending from a ring 50 carried by the table, and is closed as it swings over the parison mould, by a pin 52 depending from the cylinder 42. The fixed column 29 also carries brackets 40 which support a cylinder 41. This cylinder operates the means for applying suction to the parison moulds, and for actuating the plunger 80 that forms the initial opening in the parison. The plunger 80 slides through the upper part of the ring mould, and is surrounded by a spring 83 which normally holds it retracted from the moulding surface of the ring mould. It is forced downwards, when a gather is being made, by a plunger 82 which is carried by a crosshead 84, Fig. 4, fixed to tubular members 86 that slide in guides 87 carried by the brackets 40. The upper ends of the tubes 86 are connected by a crosshead 90 which is connected to the rod of a piston 92 on the cylinder 41. The cylinder has a depending arm 94 carrying a roller 95 which rests on the ring 50. By this construction, the cylinder is raised or lowered as the table 27 rises or falls, and when air is admitted above the piston 92, the crosshead 84 is forced downwards and the plug 80 is thrust downwards into position to form the mouth of the bottle. At the same time, extensions of the tube 86 make connection with short tubes 93 mounted on the halves of the parison mould and connected with the interior of the mould. The crosshead is connected with a source of vacuum so that suction is applied through the tubes 86 to the interior of the mould to gather a charge of metal. A blowhead 197 for supplying air for blowing the parison is carried by the clutch 31, and the head fits on to a finishing mould when the latter is raised by the lifting of the table 27. Blowing takes place while the mould is travelling, in its elevated position, from one position of rest to the next. Valves are provided for controlling the supply of air to the different operating-cylinders, and the valves are actuated by the piston of the rotation cylinder 42.

257,892.—**Glass Manufacture.** Soc. Anon. des Ateliers de Construction et Fonderies de Jeumont, Anciens Etablissements T. Haut, Jeumont, Nord, France. June 1, 1926, No. 13850. Convention date, September 5, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)

Rolling.—Relates to a watercooled roller used in apparatus for producing plate glass. According to the invention, the water is supplied through one or two axial tubes to the middle of the interior space of the roller and allowed to escape through both ends. The roller is thus cooled more uniformly, and distortion due to irregular heating is minimised. In the construction shown in Fig. 2, the water is supplied through a single tube 9 passing through one of the trunnions D, and the flow divides and passes out through passages 4, 4^1 formed in both trunnions. Spaces 11, 11^1, of larger diameter than the space in the interior of the cylinder, are formed at the ends, and the water passes through the spaces into the passage 4, 4^1 by way of radial passages 3, 3^1. The purpose of this construction is to prevent air from becoming trapped in the interior of the roller. In another construction, the trunnion C is also fitted with a water supply tube similar to the tube 9. The roller may also be provided with a central core 19, Fig. 5, to increase its weight. The core has a central partition 19^1 and the water supplied to its interior through axial tubes 9, 9^1 passes through holes 10 into the interior of the outer cylinder and escapes at the ends.

FIG.2

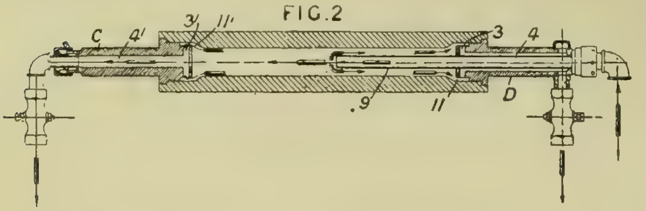
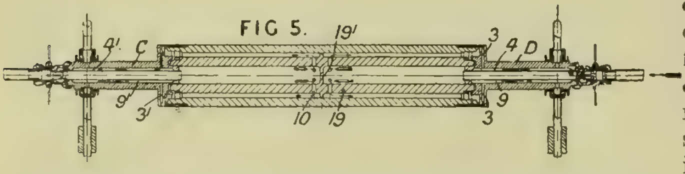


FIG 5.



258,093.—**Glass Manufacture.** Marks, E. C. R., 57, Lincoln's Inn Fields, London.—(Erie Glass Co.; Factories Building, Toledo, Ohio, U.S.A.) September 28, 1925. No. 24179. (Class 56.)

FIG.1.

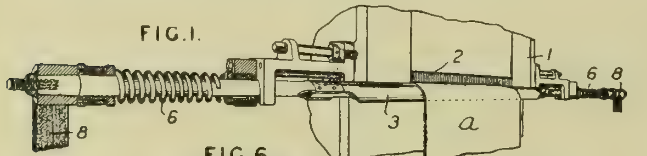


FIG.6.

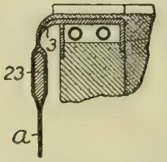


FIG.7.

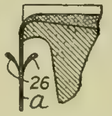
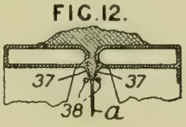


FIG.12.



Drawing.—Relates to the method of making sheet glass in which molten glass is flowed over or past a forming or surface-finishing device. According to the invention, the forming-device has a sharp edge which is in contact with the sheet and projects in the direction of flow of the glass. The forming-device may be heated and may be placed under tension. In the construction shown in Fig. 1, molten glass flows from a furnace 1 through an outlet 2 and downwardly over a discharge lip 3 in the form of a sheet a which is drawn away by suitable drawing-mechanism. The lip member 3 over which the glass flows constitutes the forming-device of the invention, and is made of heat-resisting material such as nickel chromium alloy. The lip is curved in cross-section with its convex side uppermost, and its outer edge is sharpened and projects in the direction of movement of the sheet. The sharp edge prevents the glass from collecting and travelling back as a devitrified mass and thus marring the sheet. The member 3 is preferably placed under tension by means of springs 6 to prevent it from warping, and it may be heated to the temperature of the glass by electric current supplied through leads 8. The member may consist of a thin strip and gas burners may be employed in heating it. In another construction, the sheet a after being formed is drawn over a second curved thin plate which is placed below the member 3 and serves as a final forming-device. In another construction the glass, after flowing over the member 3, may pass between gauging rods, wires, or thin strips of material 26, Fig. 7, for finishing the sheet after it is formed, and this device can be used with a sheet drawn upwards from a molten mass. The glass flowing from the lip 3 may flow along one or both sides of a forming-bar 23, Fig. 6, whence it is drawn away as a sheet a. The sheet may be formed by flowing the glass through a slot formed by two sharp-edged members 37, Fig. 12, which may be heated by resistance wires 38. The construction shown may be so arranged that the glass is drawn away horizontally instead of vertically downwards.

258,127.—**Glass Manufacture.** Jackson, W. J., Mellersh-, 28, Southampton Buildings, London.—(Hartford-Empire Co., 333, Homestead Avenue, Hartford, Connecticut, U.S.A.) November 23 1925. No. 29523. (Class 56.)

FIG.8

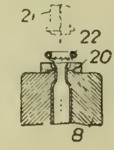


FIG.1

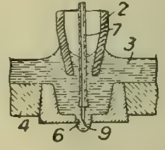
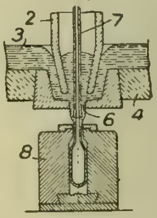


FIG.3



Blowing; delivering molten metal.—A method of making blown glassware consists in allowing molten glass to issue from an aperture in a receptacle, and in blowing the glass while it is issuing and before it is detached from the body of glass in the receptacle. The form of apparatus shown in Figs. 1 and 3 comprises a forehearth 4 having a discharge aperture 6, a hollow and vertically movable plunger 2 having its lower end submerged in molten glass 3, and a blowpipe 7 which extends through the plunger 2 and is connected at its upper end to a source of vacuum or air pressure. In the position shown in Fig. 1, the plunger 2 is at the top of its stroke, the blowpipe 7 is raised above the aperture 6, and the glass is beginning to issue from the aperture. A slight leakage of air into the blowpipe causes a hollow 9 to be formed in the issuing glass. Downward movement of the plunger forms a gather of glass below the aperture, and air blown through the pipe 7 enlarges the space 9 and forms the gather into a bubble. After the bubble has been allowed to elongate, a mould 8, Fig. 3, is closed around it and it is blown to fill the mould. The mould and the pipe 7 are next separated, and blowing is continued to burst-off the glass between the mould and the pipe. If the glass does not burst, it may be cleaned off by tool passed over the mould and the hardened neck of glass may be severed by shears from the mass in the forehearth. Finally, a burner is brought into position to reheat the stub-end of glass projecting from the aperture 6. In some cases, the plunger 2 may be emitted, the reciprocation of the pipe 7 being sufficient to control the formation of the gather.

Shaping articles after formation.—If the neck of the formed article, in this case a bottle, is to be finished, the mould is moved to a new position where a neck-former 20, Fig. 8, is closed on the upper end of the mould and a ring burner 22 is brought into position to re-heat the rough protruding edge of the glass. When the glass is soft, the burner is removed and a forming-tool 21 is lowered and co-operates with the former 20 to finish the neck of the bottle. A rotary shaping-tool or other suitable device may be used instead of the formers 20, 21. The method and apparatus may also be used for the production of electric lamp bulbs.

258,228.—**Glass Manufacture.** Tucker, O. M., Reeves, W. A., and Beatty, J. M., Innis Avenue, South Columbus, Ohio, U.S.A. July 7, 1926, No. 16954. Convention date, September 14, 1925. Not yet accepted. Abridged as open to inspection under Sect. 91 of the Act. (Class 56.)

FIG 5

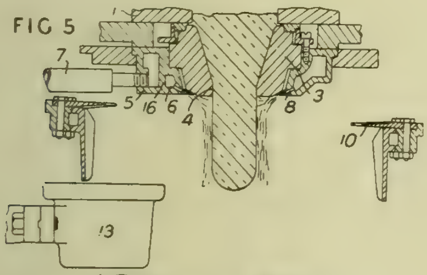
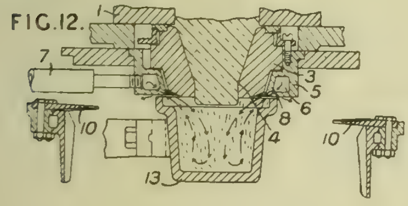


FIG. 12.



Delivering molten metal.—Relates to a glass-feeding device of the kind in which a column of metal, emerging from an outlet in the floor of a forehearth, is supported and reheated, after a "gob" has been cut off, by the pressure of gases burning in a cup which is brought up beneath the outlet. According to the present invention, the combustible gas mixture is not introduced into the cup itself but into an annular burner which surrounds the outlet and directs the flames downwards into the cup as it is brought up to the outlet. The flames also surround the emerging column of metal, when the cup is removed, and by remelting the surface eliminate scratches and defects produced by contact between the glass and the bushing. The outlet 4, Fig. 5, is formed in a replaceable bushing 3 which fits below an aperture in the forehearth 1 and is held in place by the annular burner 5. The burner is formed with a hollow annular compartment 6 which is fed with gas and air under pressure through a pipe 7 and is pierced with holes 8. These holes are formed at such an angle as to direct the continuous annular flame downwardly against the column of glass as it emerges from the outlet 4. After a "gob" of glass has been cut off the column, by means of shear blades 10, a cup 13 is swung upwards against the outlet, as shown in Fig. 12. The flames from the jets 8 are then enclosed by the cup, and the cushion of gases thus burning under pressure in the cup either retards, stops, or reverses the flow of glass through the outlet until the cup is removed. A baffle 16, Fig. 5, is fitted within the compartment 6 of the burner ring opposite the inlet pipe 7, to secure an even supply of combustible mixture at all of the holes 8. The supply of gas and air may be reduced when the shear blades 10 are cutting the column of metal. In the construction shown in Fig. 12, the cup 13 is brought close to, but not in contact with, the underside of the bushing 3, and the burnt gases escape through the space between the cup and the bushing. In a modification, the cup is brought into contact with the bushing and the gases escape through a valve in the wall of the cup. In another modification, the gases escape through outlet ports formed in the ring 5. The metal may flow through the outlet 4 by gravity, or it may be extruded by fluid pressure or by the movements of a plunger reciprocating vertically over the outlet. The cup 13 and the shears 10 are operated by compressed air cylinders, and the admission of air to the cylinders is controlled by a timing device as described in Specification 208,172. Gas and air for the burner 5 is mixed and controlled by an injector as described in Specification 109,872.

Latest British Patents.

Applications.

25932—October 18, 1926. G. H. Wingate. Manufacture of lenses.
25953—October 18, 1926. (Germany, October 20, 1925.) L. von Reis. Polishing plate glass.
26008—October 18, 1926. I. W. Boothroyd. Closures for bottles, etc.
26088—October 19, 1926. N. H. Freeman. Temperature controlling devices for furnaces, etc.
26111—October 19, 1926. (France, October 24, 1925.) R. J. de Gerson. Bottles.
26131—October 20, 1926. (United States, October 24, 1925.) G. C. Cook. Regenerative air-preheater.
26304—October 21, 1926. United Glass Bottle Manufacturers, Ltd. F. A. Hurlbut. Conveyors.
26417—October 22, 1926. W. Bernatzky. Annealing-furnace.
26630—October 25, 1926. A. B. Cleworth. Suspended furnace roofs.
26737—October 25, 1926. (Germany, November 12, 1925.) O. Bleyer. Hollow glassware.
26767—October 26, 1926. E. V. R. Marks. (Libbey Glass Manufacturing Co.) Chuck for glassware.
26974—October 28, 1926. F. Liebl. Bevelling edges of glass, etc.
27019—October 28, 1926. (Germany, October 29, 1925.) Bunzkauer Werke Lengersdorff and Co. Furnace walls, etc.
27146—October 29, 1926. United Glass Bottle Manufacturers, Ltd. E. A. C. Pryor. Annealing glass articles.

27157—October 29, 1926. R. H. Parsons. Transfer of heat between gases.

27244—October 30, 1926. South Durham Steel and Iron Co., Ltd. Building block for use in furnaces, etc.

27290—November 1, 1926. C. W. I. Thomas. Bottles, etc.

27335—November 1, 1926. (Belgium, April 27, 1926.) O. Demaret. Process of treating glass plates etc. to prevent moisture adhering thereto.

27346—November 1, 1926. (United States, October 31, 1925.) C. W. Andrews. Methods of making producer gas.

27489—November 2, 1926. (United States, December 7, 1925.) Aluminium Co. of America. Refractory articles.

28024—November 8, 1926. G. H. Gascoigne. Milk bottle.

28529—November 12, 1926. R. S. Portham. Removal of suspended material from gases, etc.

28786—November 15, 1926. (Germany, November 16, 1925.) Muhlig-Union Glass Works Co., Ltd. Production of compound sheets of glass and celluloid.

28803—November 15, 1926. (France, November 27, 1925.) J. R. F. M. Lasmolles. Gas producers.

29139—November 18, 1926. R. F. Hall. Machines for manufacture of glass articles.

29195—November 19, 1926. W. R. Innes. Manufacture of strengthened glass.

29248—November 19, 1926. J. Keith and Blackman Co., Ltd. Controlling gas burners for furnaces.

Public Inspection.

259927—October 13, 1925. C. H. F. Muller (Firm of). Attachment of iron to glass.

259953—October 16, 1925. Rhenania-Kunheim Verein Chemischer Fabriken Akt. Ges. Process for the manufacture of glass containing barium.

259965—October 16, 1925. W. J. Miller, Inc. Glass fabricating machines.

259990—October 16, 1925. P. A. Favre. Machine for making articles from glass tubing and the like.

260257—October 20, 1925. L. von Reis. Methods and devices for polishing plate glass.

260263—October 24, 1925. G. C. Cook. Regenerative air preheater.

260628—October 31, 1925. C. W. Andrews. Methods of making producer-gas.

261354—November 12, 1925. O. Bleyer. Hollow glass-ware.

261425—November 16, 1925. Muhlig-Union Glass Works Co., Ltd. Process for producing compound sheets or plates of glass and celluloid.

Specifications Accepted.

240817—October 2, 1924. Kellner and Flothmann Ges. Apparatus for reversing the supply of gas and air in gas-fired furnaces for metallurgical and other industrial purposes.

243744—November 28, 1924. Soc. Anon. des Manufactures des Glaces et Produits Chimiques de Saint-Gobain, Chauny, et Cirey. Apparatus for the equalization of the density of fluid mixtures consisting of a liquid and granular or like material.

249863—March 28, 1925. C. Heuze. Process and apparatus for the manufacture of plate glass, figured and wired glass, and the like.

252127—May 15, 1925. Soc. Anon. d'Ougree-Marihaye. Gas-valves.

252371—May 19, 1925. Hartford Empire Co. Method of and apparatus for making hollow blown glassware.

253866—June 20, 1925. Soc. Anon. des Manufactures des Glaces et Produits Chimiques de St. Gobain, Chauny, et Cirey. Apparatus for the manufacture of sheet glass.

258541—September 21, 1925. Australian Glass Manufacturers Co., Ltd. Multiple glass-stopper pressing machines.

259629—April 21, 1925. United Glass Bottle Manufacturers, Ltd. and E. A. C. Pryor. Lehrs, annealing-furnaces, or like apparatus.

259691—July 25, 1925. (Cognate Application, 32276/25.) W. Taylor, A. Warmisham and Kapella, Ltd. Mounting of lenses.

259732—September 8, 1925. J. E. Pollak (Owens Bottle Co.) Feeding glass.

259733—September 8, 1925. J. E. Pollak (Owens Bottle Co.). Machine for forming glassware.

259775—October 28, 1925. T. D. Harries. Milk bottle or utensil.

259801—December 23, 1925. A. E. White (Morgan Construction Co.). Reversal and control of regenerative furnaces.

259805—December 29, 1925. S. E. Sieurin. Production of fire-proof bricks or other products.

260041—July 22, 1925. W. J. Mellersh-Jackson. (Hartford Empire Co.) Lehrs for annealing glassware.

260086—September 25, 1925. W. Wright. Closuring or sealing of bottles.

260104—October 30, 1925. V. F. Feeny (Illinois Pacific Glass Co.). Electric Glass-annealing lehrs.

260771—October 30, 1925. T. Sutcliffe. Closures for bottles, jars and the like receptacles.

260801—December 22, 1925. A. Warmisham and Kapella Ltd. Lens systems.

260863—January 15, 1926. (Divided Application on 255329.) L. Rainchon Ash-pans for gas-producer furnaces.

261150—September 28, 1925. E. C. R. Mars (Erie Glass Co.). Manufacture of sheet glass.

261227—February 13, 1926. C. A. Dellamonica. Grinding or polishing rollers for glass and the like.

Patents, Trade Marks, Inventions.—Advice, Handbook and Consultations free. King's Patent Agency, Ltd., Director B. T. King, C.I.M.E.; Regd. Patent Agent, G.B., U.S., and Canada, 146a, Queen Victoria Street, E.C.4, and 6, Quality Court (near Patent Office), London, W.C. 39 years' references. 'Phone: Cent. 682.

" Method of and Apparatus for Melting Glass." The owners of British Patent No. 218718 desire to dispose of the same or would enter into working arrangements with a firm likely to be interested. Particulars may be obtained from TECHNICAL RECORDS, LTD., 59-60, Lincoln's Inn Fields, London, W.C.2.

" Improvements in or Relating to Apparatus for the Manufacture of Glass Tubes Provided with Closed Ends or Bottoms." The owners of British Patent No. 177884 desire to dispose of the same or would grant a license to work the invention on royalty terms. Particulars may be obtained from TECHNICAL RECORDS, LTD., 59-60, Lincoln's Inn Fields, London, W.C.2.

Patents and Designs Acts, 1907 and 1919. The Proprietor of British Patents Nos. 205736, 205737 and 205738 is prepared to sell the patents or to licence British manufacturers to work thereunder. They relate to screw-stopper bottle making machines. Address: B. W. & T., 112, Hatton Garden, London E.C.1.

No. 125921. " A Potash Glass for use as a Filter to Produce Daylight Effects." The owners of the above patent are desirous of arranging by licence or otherwise on reasonable terms for the manufacture and commercial development of the invention. For particulars address: Herbert Haddan and Co., Chartered Patent Agents, 31 and 32, Bedford Street, Strand, London, W.C.2.

The Proprietors of the Patent Nos. 29251 of 1912 and 13356 of 1913 (" Improvements in Machines for Making Hollow Glass Articles ") are desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring their full development and practical working in this country. All communications should be addressed in the first instance to Haseltine, Lake and Co., Chartered Patent Agents, 28, Southampton Buildings, Chancery Lane, London, W.C.2.

GLA

GLASS

THE RECOGNIZED ORGAN OF THE GLASS INDUSTRY

Vol. 3. No. 13. DECEMBER, 1926. ONE SHILLING

Four Points about
"RAM" Brand LIMESTONE.

I.—Selected Stone—not a by-product of stone for other Trades.
II.—Deliveries regular as clockwork.
III.—Uniform quality—the best.
IV.—"Ram" Brand is really Limespar—at Limestone price.

C. E. RAMSDEN & Co.,
FOLEY COLOUR AND CHEMICAL WORKS,
FENTON, STOKE-ON-TRENT.
'Phone: Longton 72.
Wire and Cable: Ramsdens, Stoke-on-Trent.

POTASSIUM NITRATE.
ARSENIC.
POTASSIUM CARBONATE
(HYDRATED & CALCINED)
SELENIUM.

STOCKS HELD AT PRINCIPAL PORTS.

Write to-day for Prices.
THE COOKSON PRODUCE & CHEMICAL CO., LTD.,
3, NEW LONDON ST., LONDON, E.C.3.
'Grams:—COOBUDCOL, FEN, LONDON.
'Phones:—ROYAL 3917, 8, 9, and 4048.

The Cheapest House for Glass Chemicals.

CLEGG'S
Glass Bottle Making Machines.
FOR PLAIN AND SCREW MOUTHS.

Bottle Moulds for Hand-work.

Bottle Moulds for all types of Machines.

Double Head Machine for Screw or Plain Mouths.
A. E. CLEGG, LIMITED,
ENGINEERS,
Balmoral Works, Balmoral Street, HUNSLET, LEEDS.
Telephone: 24634. Telegrams: "Clegg, Engineer, Hunslet, Leeds.

INCREASE THE EFFICIENCY
OF YOUR
FURNACES LEHRS ETC.
BY USING
Highpor Insulating Bricks
AS USED BY THE LEADING GLASS MANUFACTURERS
HIGHEST EFFICIENCY. LOWEST COST.
Send for particulars to DEPT. G.
THE BUILDING & INSULATING MATERIAL COMPANY, LIMITED.
Dene House, Ellison Place, NEWCASTLE 'Phone: Cent. 1044.
128, Hope Street, GLASGOW 'Phone: Cent. 1053.
188, West Street, SHEFFIELD 'Phone: Cent. 4038.
9, Albert Square, MANCHESTER 'Phone: Cent. 5877 & 8.
20a, Temple Street, BIRMINGHAM 'Phone: Cent. 1806.
and
VICTORIA STATION HOUSE, LONDON, S.W.1.
Telephone: FRANKLIN 6107 & 8. Grams.: CHALKINESS, SOWEST.

THE LIBRARY OF THE
JAN 10 1927
UNIVERSITY OF ILLINOIS

GLASS HOUSE MACHINERY

MILLER

Designed and Manufactured for Every Purpose

PRESSING MACHINES
BLOWING MACHINES
PASTE MOLD MACHINES
GRINDING MACHINES
CRACKING-OFF MACHINERY
CUTTING MACHINERY
BANDING MACHINERY
CUPPING MACHINERY
MOLDS AND DEVICES

FOR PRICE AND PARTICULARS WRITE

Manufactured by

MILLER MACHINE & MOLD WORKS,

Cable Address "EMILLER," Western Union Code.

705-719, ANN STREET, COLUMBUS, OHIO, U.S.A.

European Representatives:

THE BRITISH HARTFORD-FAIRMONT SYNDICATE, Ltd.
142-143, Audrey House, Ely Place, London, E.C.I.
TELEPHONE - HOLBORN 1953.

SELENIUM METAL
SELENITE OF SODA
SELENATE OF SODA
PURPLE OF CASSIUS

Liquid Gold for glass and enamel colours for glass.

Precious METAL CHEMICAL COMPOUNDS.

Johnson, Matthey & Co.,
LTD.,

73/82, HATTON GARDEN,
LONDON, : : E.C.1

Telephone: HOLBORN, 6830/8.
Telegrams: "MATTHEY, SMITH, London."

HIGHEST GRADE

"Silica" Bricks & Blocks

OF ALL SHAPES AND DIMENSIONS, AND

Plastic "Silica" Cement

FOR GLASS WORKS' USE.

TRADE MARK "SILICA."

THE OUGHTIBRIDGE SILICA FIREBRICK
COMPANY, LIMITED,

OUGHTIBRIDGE,
∴ Near Sheffield. ∴

ESTABLISHED 1858.

TO CONTAINER MANUFACTURERS

MAKE YOUR

MILK BOTTLES

ON THE NEW

McNISH THREE MOULD

COMPLETELY AUTOMATIC

BOTTLE MACHINE

AND OBTAIN

ACCURATE CAPACITY.

THE AUTOMATIC BOTTLE MACHINE CORPORATION LTD.
12 - 13 HENRIETTA STREET,
LONDON, W.C.2.

Telegrams :
PARPUBLITY, LONDON.

Telephone :
REGENT ***1639.***

CRESCENT
TRADE BM&Co MARK
BRAND

SODA ASH,

GUARANTEED 58°—98/99% SODIUM CARBONATE.

The strongest and purest form of the article in the Market, and therefore the most economical for the use of GLASS MAKERS.

BRUNNER, MOND & Co.,
LIMITED.
NORTHWICH, CHESHIRE

London Sales Office :—7, CAVENDISH SQUARE, W.1.

L.H.
A.

" HAILGLASSWARE " is made only by Ackroyd & Best, Ltd., at their Works at Morley, near Leeds, and is British from beginning to end. Ample stocks are kept at our large warehouses and showrooms, 98, Mansell Street, opposite the Tower, London, also most contractors carry stocks. This glass is a triumph of the Glass Maker's art; it is made into Illuminating Shades, Globes, Vases and Fancy Ware, etc. Plain or Decorated with artistic ceramic colours—burnt-in and washable. Insist on seeing the brand " Hailglass " on each piece. Don't let any merchant foist on you any other brand or unbranded glassware. " Hailglass " is the Queen of all Glasses.

Made only by ACKROYD & BEST, LTD.,
Glass Makers and Metal Stampers,
MORLEY, Near LEEDS, — ENGLAND.

Showrooms
32, Shaftesbury Avenue, London, W.1.
98, Mansell Street, London, E.1.
21, Waterloo Street, Glasgow.

TRADE SUPPLIED ON GOOD TERMS.

FELSPAR
for
GLASS-MAKING.

CORNWALL AND SCANDINAVIAN
FELSPAR.

DRY-GROUND AND WATERGROUND
OR IN **LUMPS.**

DELIVERED TO WORKS.

VARCOES CHINA CLAYS, LTD.,
ST. AUSTELL, CORNWALL.

SAMPLES AND PRICES ON APPLICATION.

BARBER AND KENT,
24, MARK LANE,
LONDON, E.C.3

SHIPPING FORWARDING AND
INSURANCE AGENTS.

EVERY KIND OF TRANSPORT WORK UNDERTAKEN.

KEEN THROUGH RATES QUOTED TO AND FROM ANY PART OF THE WORLD.

EXPERT PACKERS FOR MACHINERY, MOTOR CARS, ETC.

Agencies throughout the World.

Telephone : Royal 3396.
Telegrams : VIXENISH FEN.
Cables : VIXENISH.

CODES :
A.B.C 5th
BENTLEY'S
SCOTT'S.

The Pottery and Glass Trades' Benevolent Institution.

FOUNDED 1881

The only Institution of its kind in the GLASS Industry.

THE OBJECTS OF THIS INSTITUTION ARE:—

The relief or assistance by way of pension or temporary financial help of deserving poor persons of either sex, provided they are or have been in the pottery or GLASS industries or are the widows and dependents of such persons.

The assistance of young persons of either sex engaged in these industries, whose circumstances at the time preclude them from otherwise obtaining it, to acquire free of expense that Technical instruction in these industries necessary to make them more capable in the arts of making, decorating or selling pottery and glass.

ANNUAL SUBSCRIPTIONS, DONATIONS and LEGACIES are earnestly solicited.

LIST OF THOSE CONNECTED WITH THE GLASS INDUSTRY ON THE BOARD OF MANAGEMENT.

Treasurer: GEORGE E. ALEXANDER, Esq., O.B.E. Managing Director, The United Glass Bottle Manufacturers, Ltd.
Governor: W. H. STUART, Esq., J.P., Chairman, Messrs. Stuart & Sons, Ltd.
Trustees: JULES WUIDART, Esq., J. S. WILLIAMS-THOMAS, Esq., O.B.E., J.P. (Messrs. Stevens & Williams, Ltd.).
Chairman Board of Management: C. J. PRATT, Esq., Governing Director, National Glass Co., 1, Charterhouse Street, E.C. 1, Governing Director, Rankin Automatic Glass Feeder Co.
Members: S. B. BAGLEY, Esq., J.P., Director, Bagley & Co., Ltd., Knottingley; Messrs. R. S. BIRAM, The United Glass Bottle Manufacturers, Ltd.; T. DAVIDSON, Geo. Davidson & Co., Gateshead; G. MARCHAND, Colonial and Foreign Glass Ind. Ltd.; H. SHARMAN, John Walsh Walsh, Ltd., Birmingham; S. M. STUART, Stuart & Sons, Ltd., Stourbridge; F. B. TOWERS, Lewis & Towers, Bottle Works, Dalston; DUNCAN WEBB, Jun., Molineaux Webb & Co., Ltd., Ancoats, Manchester.

Bankers—**THE NATIONAL PROVINCIAL BANK.**

General Secretary—**Mr. J. G. W. James, 3, Dyers Buildings, Holborn, London, E.C.**

STEIN & ATKINSON LIMITED,

Telephone:
VICTORIA
7325-6.

47, VICTORIA STREET, LONDON, S.W.1.

Telegrams:
METASTEINA,
SOWEST, LONDON.

SPECIALISTS IN GLASS WORKS EQUIPMENT.

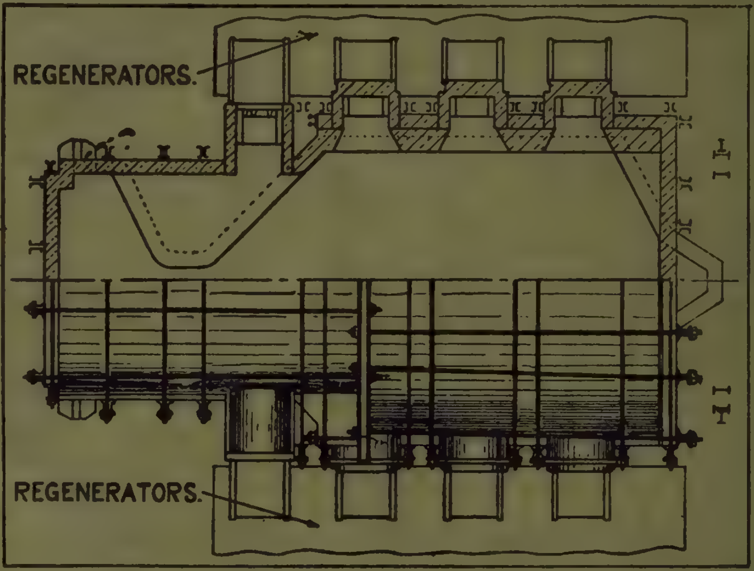
Glass Tanks.

Open and Muffle Type Lehrs with Patented Design of Conveyor Belt.

Chimneys and Bins, Reinforced Tile Construction.

Silicate of Soda Furnaces.

Caustic Pot Settings.



Stein Type Pot Furnaces.

Recuperative Revolving (patented design) Pot Furnaces for Owens Machines.

Complete Batch Storage, Mixing and Handling Equipment.

TORPEDO TYPE GLASS MELTING FURNACE

Built Under License With The United Glass Bottle Manufacturers Ltd.

REDUCED FUEL CONSUMPTION — INCREASED MELTING CAPACITY
REDUCED REPAIR COSTS.

Gas Producer with Chapman Floating Agitator.

CHAPMAN AGITATORS FOR NEW OR EXISTING GAS PRODUCERS

Over 1,100 Installed. - 160 in Great Britain.
75% Being Repeat Orders.

Savings up to :—

COAL ... 25%.
LABOUR ... 75%.

THE CHAPMAN COMPLETELY MECHANICAL PRODUCER.

THE CHEAPEST MECHANICAL PRODUCER ON THE MARKET TO INSTALL AND MAINTAIN IN WORKING CONDITION.

CATALOGUES SENT ON REQUEST.

Printed by The Surrey Fine Art Press, 31, Holmesdale Road, Reigate, and Published by the Proprietors, Glass Publications, Ltd.,
Talbot House, Arundel Street, Strand, London, W.C.2.

UNIVERSITY OF ILLINOIS-URBANA
Q.666.105GLA C001
GLASS$NORTHWOOD
3 1926
3 0112 008758309